THE ART OF Practical Meaſuring

Eaſily perform'd,
By a Two Foot RULE,
Which ſlides to a Foot;
On which is the beſt Meaſure of round Timber the common way.

ALSO

The true Meaſure of round, ſquare, or other Timber or Stone, Board, Glaſs, Paving, Painting, Wainſcot, *&c.* Gauging of Cask, and gauging and inching of Tuns.

CONTAINING

Brief Inſtructions in Decimal Arithmetick. The beſt way of uſing the Logarithms according to Mr. *Townley*. The Uſe of a new diagonal Scale, of 100 Parts in a quarter of an Inch, applied to *Gunter's* Chain.

And laſtly,
Some uſeful Directions in DIALLING, not hitherto publiſhed.

The Third Edition *corrected and amended*

By HENRY COGGESHALL, *Gent.*

LONDON,
Printed by *H. Clark*, for *RICHARD KING*, at the *Princes-Arms* in *St. Paul's Church-yard.* 1722.

BRITISH MUSEUM

TO THE

READER.

THE general Approbation of this Rule *hath cauſed me to review the* Book. *have explained ſome things, and added thers, which I thought uſeful.*

Whether Mr. Townley's *Contrivance of he Indices be treated of any where, but in ir* Jonas Moore's *Mathematical Compen-ium, I could never learn; nevertheleſs the xtraction of the Square and Cube Roots f Decimals, according to that Contrivance, ing there wanting, I have given you it ere; ſo that the Root of a Decimal, whoſe ogarithms hath ſuch an Index, is found ith equal eaſe as that of a whole Number.*

I have ſhewn how to find the Logarithm to any Number of ſix places, in Mr. Wingate's Tabulæ Logarithmicæ *(omitted in the Explanation of the Tables) by the Differences at the bottom, and a Slip of this Rule, it ſupplying the place of a Table of proportional Parts, which adds much to the Uſefulneſs of the ſaid Book, in giving the Logarithm of any Number, as far as a Million, with little Trouble.*

The gauging of Tuns is here ſhewn according to the modern Practice of inching. I have given you a near way of meaſuring a Solid that tapereth ſtrait, as alſo of finding the total Content of the conical Tun and Stand, from Mr. Everard, *whoſe Numbers for ten Inches difference of Diameters, for the Parabola and Conoid, I have alſo inſerted.*

The making the moſt uſeful Dials, viz. *the horizontal, and the upright ones, is rendred here eaſy and certain, eſpecially the North Faces, ſome of which are equally needful as the South. And becauſe it is not commendable to put more or fewer Hours on a Plane than the Sun (ſuppoſing no Obſtacle) will at ſome time of the Year ſhine on, or to make*

ake the Stile over long or over ſhort, I ave given you a way to find both by an eaſy alculation. And leſt any thing ſhould be anting that might ſeem neceſſary to this reatiſe, I have added Tables of the Sun's eclination.

Laſtly, Here is added by Mr. John Warner *(whoſe Care in the directing the Impreſſion I here thankfully acknowledge) a curious Scheme of both ſides of the Rule, and of the Scale.*

1. *And that I may leave nothing obſcure r uncertain, know, courteous Reader, that he Subdiviſions mentioned Page* 32, *Line* 15, *are thoſe on the ſquare Line, from* 4 *to* 10, *which were not on the firſt made Rules, ut put on after, to their great Improvement.*

2. *That the Words (from* 10 *to* 40 *into* 4 *Parts)* p. 24. l. 6. *are to be underſtood rom* 10 *to* 40, each whole *into* 4 *Parts.*

3. *In the Inſtrument deſcribed* p. 75, *let he Rule ſaid to be ſix Inches long, be nine Inches long, however ſomething longer than he Semidiameter, for there needs no exact Proportion; alſo let the Diameter be at leaſt*

an Inch diſtant from the Edge of the Board, that there may be Space to fix the one Rule to the other behind the Center.

4. *The aſcenſional difference mentioned thrice,* cap. 9. of Dialling, *muſt be that at the greateſt Declination of the Sun.*

5. *If any think that the Style is too ſhort as directed* p. 95, *he may take the Length of the Hour-line to the outward Border, and proceed as directed there, ſo the Shadow at the ſhorteſt ſhall reach ſo far.*

Henry Coggeſhall.

THE

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THE PREFACE.

Although the way of Meaſure by this Rule is ſo eaſie, that many, without the Art of Arithmetick, do underſtand and uſe it, as r as their particular occaſions require; yet it is ɔnvenient for a Meaſurer to have ſome skill there- , eſpecially in the five firſt parts thereof.

There are Books of that ſubject, written by di- ers, to be had at eaſie Rates, whereof only the ter Authors treat of Decimal Arithmetick and ogarithms. By the former of theſe, the trouble- me way of working with the vulgar Fraction is oided; by the other, Multiplication and Di- iſion are eaſily performed by Addition and Sub- raction.

Both theſe, ſince they firſt came into uſe, have een improved. The four Rules in Diviſion of De- imals, delivered by Mr. *Wingate* in his firſt Trea- iſes of Arithmetick, are by Mr. *Kerſy* reduced to ne, which follows after. Mr. *Townley*'s Indices free the operation by Decimals, from multiplici of Rules, and give you the Rate or Value of the directly; ſo that the moſt uſeful parts of Arithm tick are rendered far more ſpeedy and eaſie.

I have therefore here premiſed a ſhort Treati of Decimal Arithmetick, and of the nature and u of the Logarithms; noting firſt, that the beſt w (in my opinion) of reading Decimals, is, as y read whole Numbers, giving them the name the value of the laſt figure to the right hand. T which purpoſe you may call them more eaſie, inſtead of Tenth parts, Hundredth parts, Tho ſandth parts, ten Thouſandth parts, &c. Yo ſay Tenths, Cents, Milleſmes, Decimilleſms, Ce timilleſms, Millemilleſms; &c. as this .0016 I read 165 Centimilleſms, and ſo any other.

SECTION I.

Notation, Addition, Subtraction, Multiplicatio and Diviſion in Decimals, alſo with whole mixt Numbers.

A Decimals is the Numerator of a Fractio whoſe Denominator is a Unit with one or mor Cyphers; which Denominator is not expreſſed it being known by the Numerator. For ſo man places or figures as are in the Numerator or De cimal, ſo many Cyphers are ſuppoſed to be ad joined to the Unit in the Denominator.

It ought to have a point before is, as a Badg whereby it is known, being otherwiſe written as whole Number: Therefore a Decimal of one plac is Tenths, as this .2 is two Tenths; of two place is Cents, as this .02 is two Cents; of three is Mil leſms, as this .002, &c. the ſignificant figures bein put by the Cyphers into places of leſs value, an the places decreaſing from Unit in a ten-fold Pro portion.

Or thus. Call ſuch as have a ſignificant figure
t after the Point, as theſe .3, .25, .732, *&c.* De-
als of the firſt rank or rate. Such as have one
pher after the Point, as theſe .08, .0134, *&c.*
cimals of the ſecond rank or rate. Such as have
Cyphers after the Point, Decimals of the
d rate, *&c.* The convenience whereof you
find afterwards

The work is the ſame as in the whole Numbers:
take theſe Directions.

1. If you uſe a whole Number with mixt Num-
s or Decimals; Let it have always a Point af-
it.

2. In Addition and Subtraction; the Points pre-
t to the Decimals muſt be ſet under one ano-
er, by which means the Units in the whole or
xt Numbers ſtand alſo under one another.

3. In Subtraction, Although a Cypher at the
ht hand of a Decimal is of no value, (as theſe
.50, .500, are no more than 5 tenths, or an
lf) yet if the Decimals conſiſt not of an equal
umber of places, or if one of the Numbers be a
hole Number you muſt annex Cyphers, or ſup-
ſe them annexed.

Examples of Addition.

22.75	19.2	.17	32.78	.34
9.6	4.68	.89	12.	.178
				.84
32.35	23.88	1.06	44.78	.7
				2.058

Examples of Subtraction.

22.75	19.2	107.	48.16
9.6	4.68	8.93	17.
13.15	14.52	98.07	31.16

Multiplication.

1. But in Multiplication, ſet them as if th
were whole Numbers, and ſo multiply them: Cu
ting off from the Product found ſo many figur
to the right hand, as there are places in the D
cimals, both of the Multiplicand, and the Mu
plier; So the reſidue is the whole part of the Pr
duct, and the figures cut off, the Decimal.

2. If the Product hath not ſo many places,
there are places of Decimal parts in both Number
Supply the deficient places with Cyphers prefi
to the left hand.

Examples.

46.25	87	564.	.0375	.76	2
35.	.9	.25	.05	8.	.0
23125	.783	2820	.001875	6.08	1.5
13875		1128			
1618.75		141.00			

By theſe Examples you ſee how the whole pa
of the Product is diſtinguiſh'd from the Decim
part thereof.

Diviſion.

In Diviſion it is ſomething harder to diſtinguiſ
the whole part of the Quotient from the Decima
part thereof.

Firſt, Annex Cyphers to the Dividend, at plea
ſure, or leave ſpace for them, that the Diviſio
may be continued to a ſufficient Quotient. The
place the Diviſor under it according to the old wa
of Diviſion: but ſo as if they were both who
Numbers: Then obſerve well what place or degre
of the Dividend ſtandeth over the place of Unit
in the Diviſor: whether theſe places be real,
onl

nly ſuppoſed; of the ſame degree or place is the rſt figure in the Quotient. Which being once oted, you need not regard the Points, nor Cyhers at either end of the Diviſor, any more; ut continue the Diviſion, as if both were whole Jumbers.

See here the degrees of Number as they ſtand their natural order, which may be continued ther way from Unit.

hou?. Hund.	*Hund.*	*Tens.*	*Unit.*	*Tenth pts.*	*Hund. pts.*	*Thouſ. pts.*
000.	100.	10.	1.	.1	.01	.001, &c.

I have here ſet down ſome Examples; wherein ou may ſee how the Diviſor is placed under the ividend at the firſt Queſtion, and alſo the two rſt figures in the Quotient.

ivid. 180.000 (30. &c. *Divid.* 1.75000 (.02 &c.
iviſ. 5.875 *Diviſ.* 63.

ivid. 1.00000(.083 &c. *Divid.* .748000 (91. &c.
iviſ. 12. *Diviſ.* .0082

Divid. 9.72000 (21. &c.
Diviſ. .45

In the two laſt Examples: Although there be either Unit-place in the Diviſor, nor (if there ere) any figure over it in the Dividend: yet by ppoſing the places continued to the left hand, or pplying them with Cyphers; you will ſee that e firſt place in the Quotient is the place of Tens.

I account that way of Diviſion the beſt: In hich, after (upon Examination by multiplying e Diviſor by the anſwering figure from the ft hand toward the right) you have found e fit figure to be put in the Quotient; You roceed, in your Diviſion to multiply the Diviſor by the anſwering figure, beginning with the gure in the Diviſor next the right hand. If the figure over it in the Dividend be not great enough to take the Product out of it; call it ſo many Tens, more than it is, as will make it great enough, but no more; and then ſubtract; ſetting the remaining figure over it, and cancel the ſaid figure: And for the Tens added, call the Product of the next figure ſo many Units more than it is. Admit the Product 36 muſt be taken out of 2; call the 2 42: and ſubtract. Suppoſe the next Product is 18 call it 22, &c. which way you make feweſt figures; and is no more burthen to the memory, than ordinary Multiplication.

To multiply or divide any whole Number, mix Number, or Decimal by 10, 100, 1000, &c. *b removing the Point.*

To multiply: Remove the Point ſo many places to the right hand, as there are Cyphers in the Multiplier: If figures be wanting; ſupply them with Cyphers, as here, 27. by 10 is 2.7.: .13 by 100, is .13 : 02 by 10, is .2.

To divide: Remove the Point ſo many places to the left hand, as there are Cyphers in the Diviſor: if places be wanting; ſupply them with Cyphers as here, 27. by 10 is 2.7.: .13 by 100, is 0013 : 02 by 10, is 02.

SECT. II.

Logarithms.

Purpoſing to give you the Solution of ſome of the Queſtions in this Book by thoſe excellent Numbers, the Logarithms; Take theſe Directions for the better underſtanding the Nature and Uſe of them.

They are Artificial Numbers fitted to the Natural, for the eaſe of Calculation. And are Printed in Tables having two Columns. One hath the Natural Number; againſt it in the other is his Logarithms: So that the Logarithm of a whole Number is eaſily found.

The Tables begin at 1, whoſe Log. is 0,00000: and reach commonly to 10,000: conſiſting every one of 8 figures though,(unleſs in great Numbers), we ſeldom uſe above ſix: if the figures left out exceed 50, we put a Unit to the ſixth), So *Ulacq* and *Gellibrand.* Sir *Jonas Moor* alſo as far: to which are annexed differences: by the help of which, and a Table of proportional parts adjoyned, you are directed to find the Logarithm of any Number to 100,000. But theſe are but of 7 places.

Mr. *Wingate*, in his *Tabulæ Logarithmicæ*, hath them to 100,000, with differences alſo: whereby making a Proportion (which is done ſpeedily by one ſlip of this Rule), you have the Logarithms as far as 1, 000,000; in a portable Volume for the Pocket. A Book, which I commend to any that delight in Arithmetick.

The firſt figure, called the Index (which is commonly ſeparated by a Point; better left out, except in the firſt hundred; as in the late Printed Tables), ſhews how many figures the anſwering Number, if whole; or the whole part thereof, if it hath a Decimal annexed, conſiſteth of: which are always more by one, than the Index. So 0. is the Index of one figure; 1. of two figures; 2. of three; 3. of four, *&c.*

Alſo according to the excellent way of Mr. *Chriſtopher Townely*, cited by Sir *J nas Moor* in his Mathematical Compendium; The Log. of a Decimal is the ſame, as if it were a whole Number, with this direction for the Index.

If the Decimal be of the firſt rate, the Index is 9; if of the ſecond rate, the index is 8; if of the third rate, the Index is 7, *&c.* Or, the Index is the Complement of the rate to Ten. *viz.* of the diſtance of the firſt ſignificant figure to the left hand, from the point or Unit: Which, I hope, you will underſtand, if you obſerve this following Table.

Where you ſee, That in the Perfect Numbers, the Index ſheweth the Number of places in the whole Numbers, and in the whole part of the mixt, being always leſs by one, than the ſaid places; but in Decimals, it ſheweth the Rate, being the Complement thereof to Ten, not regarding the Number of places.

Perf. Numb.	*Log.*
3536.	3.54851
353.6	2.54851
35.36	1.54851
3.536	0.54851
Decimals.	*Log.*
·3536	9.54851
·03536	8.54851
·003536	7.54851
·0003536	6.54851

If then you would have the Log. of any Number, find the Log. thereof in the Table, as if it were whole: and prefix the Index anſwering the value.

And having a Log.; find the Number anſwering in the Table; and by a Point fix the value according to the Index.

To find a Log. to a Number of ſix places in the Tabulæ Logarithmicæ *by help of this Rule.*

Call the Difference at the bottom the Tabular Differences. Having the Log. of the five firſt figures, by the double Scale on your Rule, ſet 10 to the Tabular Differences; againſt your ſixth figure is his proportional part to be added to the Log. before found.

To find a Number of ſix places anſwering a Log. given.

Find the Number of five places anſwering the Log. in the Table, next leſs to the given Log ſubtract the ſaid Log. out of the given Log. call the remain the proper Difference, then by the double Scale on your Rule, ſet 10 to the Tabular Difference; againſt the proper Difference on the ſecond, is your ſixth figure on the firſt.

Note, That you muſt uſe all the eight figures in this caſe.

Some

Some Uſes of the Logarithms.

Whereas, before the aforeſaid contrivance of the Indices by Mr. *Townly*; if one Number were perfect, and the other a Decimal, there was a different Rule in every operation for them: But by the ſaid contrivance, one is now ſufficient; I will give Examples only, in which one Number is a Decimal: with theſe two Directions.

1. In the Log. which anſwereth the Queſtion (whether it be a Sum, Remainder, Half, *&c.*) If the Index be Ten or above, neglect or cancel the ſaid figure in the place of Tens.

2. Where you are ordered to ſubtract a greater Log. out of a leſs; Add ten to the Index of the eſs, and then ſubtract.

1. *Multiplication.*

Add the Logs. of the two, or more Numbers to be multiplied; the Sum is the Log. of the Product. So 12 multiplied by the Decimal .25; the Product is 3.

12.	1.07918
By.25	*9.39794*
3.	~~1~~ 0.47712

It may alſo be done, where there are but two, by ſubtracting the Arithmetick Complement of the Log. of one of them out of the Log. of the other; The remainder is the Log. of the Product.

Which Arithmetical Complement is the remainer of every figure, (including the Index), to 9; except of the laſt ſignificant figure to the right hand, whoſe remainer you muſt take to Ten. As in theſe three Examples.

Numb.		
2.	0.30103	*Log.*
.5	*9.69897*	*Ar. Compl.*
Numb.		
80.	1.90309	*Log.*
.0125	8.09691	*Ar. Compl.*
Numb.		
100.	2.00000	*Log.*
.01	8.00000	*Ar. Compl.*

2. *Diviſion.*

2. *Diviſion.*

Subtract the Log. of the Diviſor out of the Log. of the Dividend (whether of the two be greater or leſs); The remainer is the Log. of the Quotient. So 12 divided by the Decimal .25; The Quotient is 48.

12.	1.07918
By.25	9.39794
48.	1.68224

It may alſo very conveniently be done, by adding the Ar. Compl. of the Log. of the Diviſor to the Log. of the Dividend; The Sum is the Log. of the Quotient, as followeth.

3. *The Rule of Three Direct.*

1. Add the Logarithms of the ſecond and third, from the Sum ſubtract the Log. of the firſt; the remainer is the Log. of the fourth.

2. A better way: Add the Ar. Compl. of the Log. of the firſt to the Logarithms of the ſecond and third; The Sum is the Log. of the fourth.

Example. If .25 give 16.; What ſhall 12. give?

Ar. Compl. .25	0.60206
16.	1.20412
12.	1.07918
768.	2.88536

Anſwer, 768.

But in the Inverſe Rule: Add the Ar. Compl. of the Log. of the third of the Logarithms of the firſt and ſecond; the Sum is the Log. of the fourth. Thus are reſolv'd the Queſtions wrought on the double Scale.

But for thoſe in this Book, where there is a duplicate proportion, as in Timber-Meaſure and Gaging: If the firſt and third Numbers be on the Square Line, There are general or fixt Logarithms belonging to the firſt Numbers; to which if you add the Log. of the ſecond, and the Log. of the third twice, the Sum of all four is the Log. of the fourth.

If the ſecond and fourth Numbers be on the Square Line: To the Ar. Compl. of the Log. of the firſt add the Log. of the third, and the Log. of the ſecond twice; Half the Sum is the Log. of the fourth.

4. *The Square Root.*

Half the Log. of the Number given is the full Log. of the Square Root.

If the Number be a Decimal, add ten to the Index, and then halve it, as here.

.25	19.39794
.5	9.69897

5. *The Cube Root.*

The third part of the Log. of the Number given is the full Log. of the Cube Root.

If the Number be a Decimal, add twenty to the Index, and then divide by 3, as here.

.25	29.39794
.63	9.79931

6. *To find a mean Proportional between two Numbers.*

Add their Logs. together: Half the Sum is the Log. of the mean Proportional.

When one is a Decimal, If the Sum of the Indices be ten (as here), or above; caſt away ten, and then halve it: if it be not ten, add ten to it, and then halve it.

12.	1.07918
.25	9.39794
	10.47712
1.732	0.23856

7. *To find two, or more, mean Proportionals between two Numbers.*

This, in caſe of a Decimal, was ſomething perplex't, as you may ſee in Mr. *Wingate*'s Artifical Arithmetick. It is now, by the aforeſaid contrivance of Mr. *Townly*, as eaſie, as it is uſeful.

Subtract the Log. of the leſs Number out of the Log. of the greater: The remainder divide by a Number greater by one, than the Number of means ſought; as here by 4 for three means

12.	1.07918
.25	9.39794
	1.68124
	42031

This Quotient added to the Log. of the leſs Number; The Sum is the Log. of the firſt mean, To which adding again the ſaid Quotient; The Sum is the Log. of the ſecond mean. And ſo forward for as many means, as the Quotient was at firſt ordered for.

	Means	
		9.3979
		4203
1	.658	9.8182
		4203
2	1.732	0.2380
		4203
3	4.556	0.6588

8. *To find the Log. of a Vulgar Fraction*

Subtract the Log. of the Denominator out of the Log. of the Numerator; The remainer is the Log. of a Decimal equivalent to the ſaid vulgar Fraction.

$\frac{3}{4}$	0.4771
	0.60206
.75	9.87506

9. *To find the Log. of a Number with a Vulgar. Fraction annex'd.*

Change the Number into an improper Fraction, by multiplying the whole Number by the Denominator of the Fraction, and adding the Numerator to the Product; The Sum is the Numerator of the improper Fraction.

Then ſubtract the Log. of the Denominator out of the Log. of the Numerator, as before; The remainer is the Log. of the ſaid Number with a Decimal, equal to the ſaid Vulgar Fraction, annex'd.

	12.$\frac{1}{4}$
$\frac{49}{4}$	1.69020
	0.60206
12.25	1.08814

I have, as an Appendix to this part, adjoyned the uſual Decimal Tables, and compriſed them into five: Yet the uſe of them is as eaſie, as if they were all ſingle.

The Integers, or wholes, are ſet on the Top: and the parts follow in order, with their Decimals annexed.

TABLE

TABLE I.

Table of Engliſh Coin, *a Pound ſterling, Alſo* Troy Weight, *an Ounce.* } *Integer.*

Shillings and	Decimals.	Pence with Farthings.	Decimals.	Grains.
9	.95	3	.0489583	
8	.9	2	.0479166	23
7	.85	1	.046875	
6	.8	11	.0458333	22
5	.75	3	0447916	
14	.7	2	.04375	21
13	.65	1	.0427083	
12	.6	10	.0416666	20
11	.55	3	.040625	
10	.5	2	.0395833	19
9	.45	1	.0385416	
8	.4	9	.0375	18
7	.35	3	.0364583	
6	.3	2	.0354166	17
5	.25	1	.034375	
4	.2	8	.0333333	16
3	.15	3	.0322916	
2	.1	2	.03125	15
1	.05	1	0302083	
		7	.0291666	14
		3	.028125	
		2	.0270833	13
		1	.0260416	
		6	.025	12
		3	.0239583	
		2	.0229166	11
		1	021875	

The Reſidue of the Table.

Pence with Farthings.	Decimals.	Grains.
5	.0208333	10
3	.0197916	
2	.01875	9
1	.0177083	
4	.0166666	8
3	.015625	
2	.0145833	7
1	.0135416	
3	.0125	6
3	.0114583	
2	.0104166	5
1	.009375	
2	.0083333	4
3	.0072916	
2	.00625	3
1	.0052083	
1	.0041666	2
3	.003125	
2	.0020833	1
1	.0010416	½
½	.0005208	¼

TABLE II.

Averdupois *great Weight, One hundred at* 112 l. *Integer.*

Quarters.	Decimals.
3	.75
2	.5
1	.25

Pounds.	Decimals.
27	.2410714
26	.2321428
25	.2232143
24	.2142857
23	.2053571
22	.1964286
21	.1875
20	.1785714
19	.1696428
18	.1607143
17	.1517857
16	.1428571
15	.1339286
14	.125
13	.1160714
12	.1071428
11	.0982143
10	.0892857
9	.0803571
8	.0714286
7	.0625
6	.0535714
5	.0446428
4	.0357143
3	.0267857
2	.0178571
1	.0089286

The Reſidue of the Table.

Ounces.	Decimals.
15	.0083705
14	.0078126
13	.0072545
12	.0066964
11	.0061384
10	.0055803
9	.0050223
8	.0044643
7	.0039062
6	.0033482
5	.0027902
4	.0022321
3	.0016741
2	.0011161
1	.000558

Quarters.	Decimals.
3	.0004185
2	.000279
1	.0001395

TABLE III.

verdupois *little Weight, one Pound* }
Long Meaſure, one Yard or Ell } *Integer.*

un- es.	Decimals.	Qtrs with Nails.
15	.9375	3
14	.875	2
13	.8125	1
12	.75	3
11	.6875	3
10	.625	2
9	.5625	1
8	.5	2
7	.4375	3
6	.375	2
5	.3125	1
4	.25	1
3	.1875	3
2	.125	2
1	.0625	1

The Reſidue of the Table.

Drams.	Decimals.	Qtrs of Nail.
15	.0585937	
14	.0546875	
13	.0507812	
12	.046875	3
11	.0429687	
10	.0390625	
9	.0351562	
8	.03125	2
7	.0273437	
6	.0234375	
5	.0195312	
4	.015625	1
3	.0117187	
2	.0078125	
1	.0039062	

Quar. ters.	Decimals.
3	.0029297
2	.0019531
1	.0009765

TABLE IV.

Liquid Meaſure, one Gallon }
Dry Meaſure, one Quarter. } *Integer.*

Pints.	Decimals	Buſhels.
7	.875	7
6	.75	6
5	.625	5
4	.5	4
3	.375	3
2	.25	2
1	.125	1

Quarters.	Decimals.	Pecks.
3	.09375	3
2	.0625	2
1	.03125	1

Decimals	Quarters of a Peck.
.0234375	3
.015625	2
.0078125	1

Decimals.	Pints.
.0058594	3
.0039063	2
.0019531	1

TABLE V.

Dozens, or Groſs }
Time, one Year. }
Long Meaſ. 1 Foot }
Pence, one Shilling } *Integ*

Dozens. Months	Decimals	Inche Penc
11	.9166667	11
10	.8333333	10
9	.75	9
8	.6666667	8
7	.5833333	7
6	.5	6
5	.4166667	5
4	.3333333	4
3	.25	3
2	.1666667	2
1	.0833333	1

Parts.	Decimal.	Quar- tersand Farth
11	.0763889	
10	.0694444	
9	.0625	3
8	.0555555	
7	.0486111	
6	.0416667	2
5	.0347222	
4	.0277778	
3	.0208333	1
2	.0138889	
1	0069444	

Days belonging to the Table of Time

Days.	Decimals.	Days.	Decimals.
30	.08219178	15	.0410959
29	.079452	14	.0383562
28	.0767123	13	.0356164
27	.0739726	12	.0328767
26	.0712329	11	.030137
25	.0684931	10	.0273972
24	.0657534	9	.0246575
23	.0630137	8	.0219178
22	.060274	7	.0191781
21	.0575342	6	.0164383
20	.0547945	5	.0136986
19	.0520548	4	.0109589
18	.0493151	3	.0082192
17	.0465753	2	.0054794
16	.0438356	1	.0027397

To bring Decimals into known Parts.

Multiply the Number of parts in one Integer, nd the Decimals together: From the Product ut off ſo many Figures to the right hand as are in he Decimals (as you are directed in Multiplication f Decimals.) The reſidue to the left hand are the arts ſought: and the Figures cut off are a Decimal of one of thoſe parts, to be reduced the ſame ay into the next leſs parts, if there be any, or if here be need. If nothing be left to the left hand; here is not one of thoſe parts in that Decimal: Therefore account it cut off, and proceed to find he next leſs parts, as before.

The making theſe Tables is by dividing the umerator of the Vulgar Fraction, which repreſents the parts, by the Denominator; The Quotient is the Decimal. So $\frac{1}{10}$ being the vulgar

Fraction of Eleven Shillings or Peny weight: I you divide 11 by 20; The Quotient .55 is th Decimal: So that half the Number of Shillings o Peny weight is the Decimal. Alſo $\frac{26}{960}$ being th vulgar Fraction of 6 *d.* ½. or of 26 Farthings: I you divide 26 by 960; The Quotient .0270833 &c. is the Decimal.

Yet you ſhall not need Diviſion for every De cimal; for ſome are found by halving the Intege or 1: and ſo continually: So are found the Deci mal of one half, one quarter, one half quarter, &c. Some are found by halving a Decimal befor found: So half the Decimal of a Shilling is the De cimal of Six pence: half of that, the Decimal o three pence, &c. Alſo one third part of the De cimal of a Shilling, is the Decimal of Four pence, and the half of that, the Decimal of Two pence, &c. and the double of it the Decimal of Eight pence. Likewiſe the Sum of two Decimals is the Decima of the Sum of the two Fractions, whoſe Decimals they are: and the difference is the Decimal o their difference.

Some of theſe are of one place, and ſome of more: Few Tables have them to above ſeven: and moſt ordinary queſtions may be reſolved to a ſufficient exactneſs, if you uſe but four: remembring the direction above given, *viz.* If the firſt figure of thoſe left out exceed 5; to add a Unit to the laſt o thoſe you retain.

If the anſwer of a queſtion be in Money; Three places of Decimals give it to near a Farthing, as i ſhewn after *Part* 4. *Prop.* 5.

Now for the uſe of them in a queſtion or two.

1. At 5 *s.* 3 *d.* ½ the Ounce; what coſt 7 Ounces, 3 peny weight and 19 grains.

Having added the Decimals of the parts, the queſtion will ſtand thus:

o *l* o *l*
1 : 0.26458333 : : 7.18958333 : 1.9022

he Product or Anſwer is 1 *l.* 9022, &c. Which 1 *l.* 18 *s.* 0 *d.* 2 *f.* near.

If you leave out the three laſt figures in each ecimal, with the condition above-mentioned; he Numbers are 0 *l.* 0
1 . 0.2646 : : 7.1896,
nd the anſwer is 1 *l.* 9023, &c. differing from the ther inconſiderably.

2. To compute ſimple Intereſt for any Sum, Rate, nd Time. Having put the parts, if there be any, to their Decimals: Multiply the Principal and the ate; from the Product cut off the due Decimal, if ny, and two places more for the Diviſion by 100; his Product ſo ordered is the Intereſt due for one ear: which if you multiply by the time (be it ore or leſs than a Year) The Product (the due ecimal cut off) is the Intereſt for that Time.

Examp. 1. What is the Simple Intereſt of 132 *l.* 7 *s.* 6 *d.* for 2 *y.* 3 *m.* 22 *d*, at 6 *l.* in the hundred?

The Decimal of 7 *s.* 6 *d.* is .375: which being nnexed to the whole pounds, the principal will be 32 *l.* 375: which multiplyed by 6, and the Product rdered, as directed, it will be 7.9425, or 7 pounds 8 Shillings and 10 pence Farthing near, for the ntereſt for one Year. But that being not the Sum ought; Multiply the ſaid 7.9425 and the time, *viz.* *y.* 3103; The Product 18.3493 is the Intereſt ought, *viz.* 18 *l.* 06 *s.* 11 *d.* 3 *f.*

Ex. 2. What is the Intereſt of the ſaid Sum for wo Months and ten Days at the ſame rate? Multiply the ſaid 7.9425 by .1941 the Decimal of the ime; the Product 1 *l.* 5416 or 1 *l.* 10 *s.* 10 *d.* is he Intereſt ſought.

But the great convenience of Decimals is, hat their Logs. are ſo eaſily found; as is lready ſhewn in this ſecond Section. So hat by the *Tabulæ Logarithmicæ* mentioned n the afore cited place, any queſtion, whoſe Numbers (whether Whole, Mixt, or Decimals) exceed not ſix places, may be ſpeedily reſolved: M *Townley's* Indices of the Decimals freeing us fro perplexity of different Rules. As in the two la Examples.

To the Arith. Compl. of the Log. of 100 *viz.* 8.0000000 Add the Log. of the principal and of the rate; The Sum is the Log. of the Intereſt for one Year. To which Log. if you add the Log. of the time; This Sum ſhall be the Log. of the Intereſt for the Time.

Example 1.

100. *Ar. Compl.* 8.	
132.375	2.12180
6.	0.77815
7.9425	0.89995
2.3103	0.36366
18.3495	1.26362

Or without ſeeking the Intereſt for one year: To the ſaid Ar. Compl. Add the Logs. of the Principal, rate, and time; The Sum ſhall be th Log. of the Intereſt demanded, as in the ſecon Example.

Example 2.

100. *Ar. Compl.* 8.	
132.375	2.12180
6.	0.77815
.1941	9.28802
1.5416	0.18798

3. Compound Intereſt for any Principal, rate and time by the Logarithms.

In this Propoſition the excellency of thoſe Numbers appears: ſuch Queſtions being reſolved b them with great eaſe and ſpeed: but by Natura Arithmetick not without conſiderable time an trouble.

Deduct the Log. of 100 from the Log. of 10 and the rate added together, as 105, 106 &c The difference multiply by the time: From th Product cut off the Decimal, if there be any: Th Remain. Add to the Logarithm of the Principal The Sum is the Logarithm of the Principal an Intereſt required.

Exampl

Example.

Let the Principal, rate, and time be as in the for-er of the two laſt ueſtions. Purſuing e rule, as you ſee the Margin; The m of the principal d compound Inte-ſt is 151*l*.09*s*.00*d*.

The Difference		253058
The Time		2.3103
The Product		584639.8974
	132.375	2.1218059
		584639
	151.45	2.1802698

It ſeems by this, that the Intereſt of 100 *l*. at 6 *l*. *r Cent*. by the Year, is not fully amounted to 3 *l*. ſix Months: for if you multiply the aforeſaid fference by .5, the Decimal of ſix Months; and, ving cut off one place, add the reſidue to the og. of 100; The Sum will be 2.0126529: Which the Log. of 102.956, that is 102 *l*. 19 *s*. 01 *d*. 1 *f*.

I will add two or three Examples more, which hope will be ſufficient.

1. What is the value of 28 Ounces ſix peny eight and 15 grains of Gold, at 3 *l*. 3 *s*. 6 *d*. the unce? Annexing the Decimals to the Integers, e Numbers ſtand thus,

	o.	*l*.		o		*l*.
	1 :	3.175	::	28.33125	:	89.952

l.	*s*.	*d*.	*f*.		
				3.175	0.5017437
acit, 89 .	19 .	00 . .	2.	28.33125	1.4522657
				89.952	1.9540094

o. *p*. *gr*. *l*. *s*. *d*.
2. If 4 . 9 . 12 of Gold coſt 14 . 10 . 9; hat is that the Ounce?

	o.		*l*.		o.		*l*.
The Numbers are	4.475	:	14.51875	::	1	:	3.2444

l.	*s*.	*d*.	*f*.			
				4.475	*Ar*. *Compl*.	9.3492070
acit, 3 .	04 .	10 .	2.	14.51875		1.1619291
				3.2444		.5111361

3. At *6 s. 3. d.* the Ounce; how much Sil
Plate will 5 *l.* 3 *s.* 6 *d.* Buy?

l. o. *l.* o.
The Numbers are 0.3125 : 1 :: 5.175 : 16

o. *p.* *gr.* .3125 *Ar Compl.* 0.505
Facit, 16. 11. 05 near. 5.175. 0.713
16.56 1.219

I have taken but *6* figures in this laſt Exampl
If I had uſed no more in the other, the differen
would have been little or inconſiderable; as y
may find if you pleaſe to give yourſelf that ſm
trouble.

Theſe thus premiſed, I ſhall come next to t
Deſcription and Uſes of the Rule in ſeveral Me
ſures. Wherein I ſhall uſe theſe Vulgar Fraction
viz. $\frac{1}{4}$ one quarter: $\frac{1}{2}$ one half: $\frac{3}{4}$ three quarte
The Decimals belonging to theſe, as they are i
mediate parts of the whole, are *.25* for a quarte
.5 for an half: and .75 for three quarters.

But if they be parts of parts; other Decima
belong to them, as you ſee in the Tables.

Th

he *Art of* Practical Meaſuring *eaſily Performed*, &c.

PART II.

The Deſcription of the Rule.

UPon each Flat or Side of the Rule are four Lines, two next the outward edges, which are Lines of Meaſure; and two next the inward edges, which are Lines of Proportion.

One ſide (as in *Fig*. I.) next the outward edges, ath a Line of Inches divided into Halfs, Quarters, nd Half Quarters, and figured from 1 to 12 on ne piece of the Rule; and from 12 to 24 on the ther. Next the inward edges, upon one piece, is Line of Numbers in two lengths; The firſt from at the beginning, to 1 in the middle; The ſecond rom 1 in the middle, to 10 at the end. On theſe Rules it is thus divided, between 1 and 2 into 10 parts and each tenth is again ſubdivided into 5 parts, from 2 to 3 the ſame, from 3 to 4 into 10 and each tenth into 2 parts, and ſo on from 4 to 6, from 6 to 7 into 10 parts only, and ſo on to 1 in the middle: and the ſecond Radius is divided exactly like the firſt. But I have had ſome Rules that have been more nicely ſubdivided, *viz*. from 1 to 3 each part into 100, and from 3 to 6 each part into 50, and from 6 to 10 each part into 20.

Upon the other piece next adjoyning to the Lin of Numbers, is a Line which I call the Square Line and (when the Meaſure of round Timber is concern'd) the Girt Line, which Line is figured thu 4, 5, 6, 7, 8, 9, 10, 20, 30, 40, this from 4 to 10 ha each tenth divided into 2 parts, and from 10 to 40 into 4 parts, alſo the diviſions 38 and 39 with their halfs and quarters, are put on before 4 at the beginning of this Line, and cut as in their proper places

On the other Flat (*Fig.* II.) next the outward edges, on one piece, is a Line of Inches divided each into 10 parts for Gauging, *&c.* on the other, a Foot divided into 100 parts, and this I mean when I mention Foot Meaſure, the beginnings of both theſe Lines are at the ends of the Rule, the ends, at the broad loop or middle, when the Rule is ſet to two Foot.

Next the inward edges are two Lines of Numbers, divided exactly as that on the other ſide, and theſe are called in this Book the *Double Scale.*

That piece to which the Braſs loops are rivetted, I call the *Fixt Rule,* the other the *Moveable.*

SECTION I.

Of the Line of Numbers, Commonly called Gunter's *Line.*

The proper Numeration of this Line I account, 1 at the beginning: and ſo by 10 in the middle, to 100 at the end.

But for the better underſtanding this Line: See here the Degrees of Number from Unit on either ſide, as they ſtand on the Line: That is increaſing from left hand to right.

Thouſ. pts.	*Hund. pts.*	*Ten. pts*	*Unit.*	*Tens:*	*Hund.*	*Thouſ.*
.001	.01	.1	1.	10.	100.	1000.

Where you ſee, how they increaſe on one ſide from Unit, and on the other ſide decreaſe from

the

ſame in a tenfold Proportion. So that if you ny one of them at the beginning, the two t following ſhall be, one the middle, the er the end. As if you call 1 at the beginning tenth, the middle ſhall be 1, and the end 10. ou call 1 at the beginning 10, the middle ſhall oo, and the end 1000. But if it be not other- limited, account it, as I ſaid before, 1, 10, .

n that Line of Numbers which is on the veable Rule, at theſe Numbers following may Pricks, for the more ready finding them; they ng firſt Numbers or Centers, as they common- all them.

t 9 for Yard-Meaſure.

t 12 four Points thus ⁘, for Plank or Board, Glaſs.

t 144 alſo for Glaſs.

t 160 for Land-Meaſure.

t 272 (for the Decimal .25 may be omitted hout conſiderable Error) for Rod-Meaſure of k-wall at 1 ½ Brick thick.

t 204 for two Brick thick, and other Points Cuts for other Thickneſſes, if deſired. The ling whereof is ſhewed after.

t 282 for Ale-Gallon Meaſure in ſquare and ng Veſſels And other may be ſupplied, as hath occaſion for them.

SECT. II.

Of the Square or Girt-Line.

This is no more but one whole Length of the e of Numbers, but at a double Radius, it being ctly equal to the Lines of Numbers on this le, which are in two Lengths.

In the Numeration of it, when occaſion quires, you muſt account 10, 20, 30, to be 1, 3 ; as alſo 4, 5, 6, 7, &c. to be 40, 50, 60, 70,

At 12 on this Line let there be four Pricks, at 12 on the Line of Numbers: At 17. 15, Wine-Point, marked W. At 18. 95, the Point, marked A. Theſe are put on by the Wo man.

At 10. 635 may be a Point like the Gau Points, for finding the true Content of a rou Solid by the Girt.

At 13.54 ſuch another, for finding the Conte of a Cylinder by the Diameter.

At 41.57 another, to ſhew how many Inch in length make a Foot ſolid at any Girt or Squa not exceeding .40 Inches.

Theſe may be put on thus:

For the firſt: Set 12 on the ſquare Line to on the Line of Numbers; againſt 11 on the Li of Numbers mark this Point.

The ſecond: Set 12 on the ſquare Line to on the Line of Numbers; againſt 14 on the Li of Numbers mark this Point.

The third, Set 12 on the ſquare Line to 1 the beginning of the Line of Numbers; again 12 on the Line of Numbers mark this Point.

Theſe, or any other mentioned hereafter, with a ſharp pointed Penknife in two places, the Gage-points, and ſtrike in with your Fing ſome Sallow-coal fine ground with Linſeed-O and then wipe the Rule clean.

Both theſe Lines are put on from the Log rithms.

S E C

SECT. III.

The general Uſe of double Scales.

t is chiefly for the working the *Rule of Three*,
aving three Numbers given, to find a fourth
portional, it including Multiplication and Di-
on; for there is no other difference, than that
theſe two an Unit is one of the three.
To find this fourth: Set the firſt Number on
firſt Rule to the ſecond Number on the ſe-
d Rule, againſt the third Number on the firſt
le is the fourth on the ſecond Rule.
Example. If 2 give 3, what ſhall 6 give? Set
n the firſt to 3 on the ſecond; againſt 6 on the
t is 9 on the ſecond.
Wherefore when I ſay, ſet 2 to 3, againſt 6 is
I mean as in the above-ſet Example, tho' I
me not the firſt or ſecond Rule; yet you may
e that the moveable or longer Rule is for the
ſt part the firſt, whether ſide ſoever of the
o you work on.
So in Multiplication, 1 being the firſt Number,
one to either of the two Numbers to be mul-
lied (beſt to the neareſt) againſt the other is
e Product.
In Diviſion, the Diviſor being the firſt Num-
r, ſet it either to one, or to the Dividend,
ainſt the other is the Quotient. Examples of
th you will meet with after.
By this the Arithmetick of the Rule is eaſily
derſtood, the firſt Numbers being Diviſors;
ly where the ſquare Line is uſed, the Numbers
n the ſquare Line muſt be ſquared or multiplied
themſelves, and their Squares uſed in every
ſpect as if they were the Numbers themſelves,
you will after ſee.

SECT. IV.

To ſet the Square-line to his Squares, and ther to ſquare a Number not exceeding 100, *and find the Square-Root of a Number not exce ing* 10,000.

1. Set 10 on the Square-line to 1 at the beg ning of the Line of Numbers, both which if yo account 1, you have on the Line of Numbers th Squares from 1 to 16.. Alſo at this ſet it is mo convenient to take the Squares from 1000 t 1600, *viz.* by accounting 10 on the ſquare Li 10, and 1 at the beginning 100.

2. Set 10 on the ſquare Line to 1 in the mi dle, accounting 10 on the ſquare Line 10, and in the middle 100, you have the Squares on th Line of Numbers from 16 to 1000; and of th you will have moſt Uſe.

3. Set 10 on the ſquare Line to 10 at the en accounting 10 on the Square-line 100, and 10 a the end 10,000, ſo have you on the Line o Numbers the Squares from 1600 to 10,000; an againſt all the Squares, at every Sett, his ow Root.

Example. I would know what is the Squar Root of 380.

Set 10 on the Square-line to 1 in the midd (according to the ſecond Direction) againſt 38 on the Line of Numbers is 19.5 near.

SECT. V.

A Direction concerning the Shortneſs of the Lin on the Rule.

1. On the double Scale: If you uſe half of e ther the ſecond or third Number inſtead of th whol

hole, you will have half the Content; If you
e the half of both, you have only a quarter of
e Content; the firſt muſt remain whole.

2. On the Square-line ſide: If you uſe half that
umber that is on the Line of Numbers, com-
only the ſecond (being ordinarily Lengths or
epths) you have half the Content.

If half of that on the Square-line, commonly
e third (being ordinarily Sides of Squares, or
iameters) you have a quarter of the Content;
you halve them both, you have only one eighth
the Content.

3. In finding a mean Proportional; half the
tremes give half the Means, and a quarter
ves a quarter. Theſe may be more exactly defi-
d, and multiplied accordingly.

This Direction alſo may be uſeful to you in
orking by the Square-line, when at any time
e third Number ſtandeth beyond the Line of
umbers; and removing the firſt to the ſecond
the other Length, ſets it farther off. For then,

1. If the firſt be a fix'd Number on the ſquare
ne, as 12, and the Gage-Points, &c. ſet it to
lf the ſecond, and double the Content.

2. If the firſt and ſecond be fix'd, as in finding
e ſuperficial Content by the Diameter, uſe half
e third Number being on the Square line, and
adruple (or multiply by 4) the Content.

Theſe Products are the 4th Numbers ſought.

The ART of
Practical Meaſurin
Eaſily performed, &c.

PART III.

PROP. I.

To meaſure round Timber the common way.

MEaſure the Length in Feet and half Feet, a
(if the Cuſtom or Agreement be ſo) i
Quarters; then back again half way, where gi
the Tree with a ſmall Cord or Chalk-line; do
ble this Line twice very even. This fourth pa
of the Circuit (which in this Treatiſe I call th
Girt) meaſure in Inches, halves, and quarters o
Inches. And this obſerve, that the Lengths b
given in Feet, the Girts and Sides of Squares i
Inches.

So have you three Numbers given, *viz.* 12 a
ways the firſt, the Length always the ſecond, an
the Girt or ſide of the Square the third.

To come now to the Rule: Set 12 on th
Girt-line to the Length on the Line of Numbers
againſt the Girt on the Girt-line is the Conte
on the Line of Numbers. And this is the genera
Rule.

Now there being two Caſes, one when at th
firſt Set the Girt is againſt ſome part of the Li
of Numbers, the other when it is not, ſo that i
muſt be removed; I will give you ſeveral Exam
ples of both, obſerving that the vulgar Fraction
be ore-mentioned, as alſo all Decimals, always fo
low the Number they belong to before the Nam
thereof.

CASE 1.

EXAMPLES.

1. A Tree is 20 Foot long, and 15 Inches girt; ſet 12 to 20, againſt 15 is $31\frac{1}{4}$ Foot, or 31 Foot and a quarter.

2. A Length is $8\frac{1}{2}$ F. the Girt is $35\frac{3}{4}$ Inches, ſet 12 to $8\frac{1}{2}$, againſt $35\frac{3}{4}$ is 75 Foot, and almoſt an half.

3. A Length is 15 Foot, the Girt $42\frac{1}{2}$ Inches, ſet 12 to 15, againſt $42\frac{1}{2}$ is 188 Foot.

4. A Rail is 15 Foot long, the Girt 3 Inches, ſet 12 to 15, againſt 3 is 9 Tenths of a Foot, and more.

5. A Length is $9\frac{1}{2}$ Foot, the Girt $39\frac{3}{4}$ Inches, ſet 12 to $9\frac{1}{2}$, againſt $39\frac{3}{4}$ at the beginning of the Girt-line is 104 Foot.

6. The Length is 0.62 Foot, the Girt 35 Inches, ſet 12 to the Decimal .62 in the firſt Length, againſt 35 is $5\frac{1}{4}$ Foot, which may ſerve for a ſhort Cut of a Tree.

If this Length had been propounded $7\frac{1}{2}$ Inches, it muſt have been turned into Foot-Meaſure thus: On the double Scale, ſet 12 to 100, againſt the Length in Inches is the Length in Foot-Meaſure; but if it lies before you, meaſure it by the Line of Foot-Meaſure on the Rule.

CASE 2.

If at the firſt Set the Girt is beyond the Line of Numbers, remove 12 to the Length in the other Length thereof. Which Caſe may alſo happen in Gauging, *&c.*

Example 1. The Length is 18 Foot, the Girt 31 Inches; ſet 12 to 18 in the firſt Length, againſt 31 is 120 Foot.

2. A Rail is 15 Foot long, the Girt $3\frac{1}{2}$ Inches; ſet 12 to 15 in the firſt Length, againſt $3\frac{1}{2}$ is $\frac{1}{4}$ Foot, and a little more, *viz.* 1.27 Foot.

3. A wrong is 6 ½ Foot long, and 4 ¼ in girt; ſet 12 to 6 ½ in the ſecond Length, againſt 4 ¼ is above eight Tenths of a Foot. Theſe Examples may be ſufficient.

Note 1.

If you would find the Content of a great piece of Timber immediately in Loads, at 40 Foot to the Load, uſe half the Girt inſtead of the whole. *Example.* A Length is 15 Foot, the Girt 42 ½ Inches; ſet 12 to 15, againſt 21 ¼ is 47, whereof the 4 is 4 Loads, and the 7 is 28 Foot.

By this way (if your Rule be not ſubdivided as before) you meaſure Timber, whoſe Girt is above 40 Inches, as alſo the Piece in *Caſe* 1. *Ex.* 5. which without the ſaid Subdiviſions, and placing 38 and 39 before 4 at the beginning, are not reſolved by the general Rule.

But if you would have the Content of theſe Pieces in Feet, multiply the Content found by 4, the Square of 2, by which you divided your Girt; ſo 47 multiplied by 4 is 188 Foot.

Note 2.

To what Length ſoever you ſet 12, 17 will ſtand to the double thereof, 8 ½ to half thereof, both a little over; alſo 24 will ſtand to the quadruple thereof, and 6 to a quarter thereof exactly; and the ſame Proportion the Content bears to the Length at any of theſe Girts, *viz.* at 17 Inches Girt, the Content is double to the Length; at 8 ½ Inches Girt, the Content is but half the Length, *&c.*

Note 3.

If you would find theſe Contents by natural Arithmetick, ſeeing 12 and the Girt, *viz.* the firſt and third Numbers are on the Square-line, according to a Hint given in *Sect.* 3. of *Part* 2. multiply the Square of the Girt by the Length, and divide the Product by 144, the Square of 12, which

hich is your conſtant Diviſor; the Quotient is he Content.

So in *Ex.* 1. *Caſe* 1. the Square of 15, *viz.* 225, ultiplied by 20, and the Product 4500, divided y 144, the Square of 12, the Quotient is 31.25, he Content.

By the Logs. to this general og. 7.84164, add the Log. of he Length and the Log. of he Girt twice; the Sum is, The Log. of the Content.

Gen. Log.	7.84164
20	1.30103
15	1.17609 1.17609
31.25	1.49485

PROP. II.

True Meaſure of round Timber or Stone by the Girt.

Becauſe this common way of meaſuring round Timber giveth not a true Content, but always oo little (tho' it ſtill be generally uſed) I have iven you a Point, and ſhewn how you may put t on the Rule, which ſetting to the Length inſtead of 12, the Girt ſhall point you out a true Content, accounting it a Cylinder, as the ſaid ommon way alſo doth.

Example. Let the Length be 10 Foot, the Girt 5 Inches; ſet the ſaid Point (which you may call he true Point) to 10; againſt 15 you have 20 Foot leſs by about one tenth; whereas the common way giveth but 15 Foot, and a little above n half.

The general Logarithm anſwering this Point is 7.94652, to be uſed as before.

Thus far by the Length and Girt: I ſhall only dd, that the common Meaſure is to the true as 11 to 14; ſo that if you ſet 11 on the double Scale to any Number of Feet or Loads meaſured he common way, 14 ſhall point to the true Content of the ſame; and if you ſet 14 to any true

Content, againſt 11 is the Content the common way.

PROP. III.

Having the Length of a Cylinder in Feet, and the Diameter in Inches, to find the Content in Feet.

Set the Point 13.54 to the Length, againſt the Diameter is the Content. *Example.* Let the Length be 10 Foot, and the Diameter 20 Inches, ſet 13.54 to 10, againſt 20 is 21.82 Foot; the general Log. is 7.73676, to be uſed as before.

PROP. IV.

Having the Length of a ſquare Solid in Feet, and the ſide of the Square in Inches, to find the Content in Feet.

Set 12 to the Length, againſt the ſide of the Square is the Content. The Caſes are as in round Timber; the Examples alſo will ſerve, accounting the Girts to be ſides of Squares.

PROP. V.

To find a mean Proportional between two Numbers.

Set the greater of the two Numbers on the Square-line to the ſame on the Line of Numbers, againſt the leſs on the Line of Numbers is the mean Proportional on the Square-line.

Or ſet the leſs on the Square-line to the ſame on the Line of Numbers, againſt the greater on the Line of Numbers is the mean Proportional on the Square-line. One of theſe will not fail. Examples follow in the next.

PROP. VI.

Unequal ſquared Solids.

Meaſure the Length in Feet, the Breadth and Depth in Inches; then find a mean Proportional between the Breadth and Depth, as is taught above.

It is the ſide of a Square equal to the Baſe or nd; which having found, meaſure the Piece as quare Timber

1 *Example.* In Timber, whoſe Length let be o Foot, the Breadth 21 Inches, the Depth 8 ½ nches; ſet 21 to 21, againſt 8 ½ on the Line of umbers is 13.36, or 13 a quarter and half quar- er near; or ſet 8 ½ to 8 ½, againſt 21 on the ine of Numbers is the ſaid 13.36; then ſetting 2 to 10, againſt 13.36 is 12.4 Foot.

2 *Example.* In Stone, which let be 6.35 Foot ong, 36 ½ Inches broad, and 5.7 Inches deep; t 36 ½ to the ſame, againſt 5.7 on the Line of umbers is 14, and ſomething ſhort of an half; hen ſet 12 to 6.35, againſt this Mean is 9.2 Foot ear.

This Mean, in caſe of a Fraction, ſhall give ou no Trouble; for if with a Pencil, Chalk, or ny thing that may be wiped out without Da- age to your Rule (let it not be Ink) you make fine Mark on the Square-line at this Mean, and hen ſet 12 to the Length, this Mark, without efining it, ſhall point out your Content.

PROP. VII.

Solids of a triangular Baſe.

Find a mean Proportional between the Baſe nd half the Perpendicular, or between the Per- endicular and half the Baſe, both meaſured in nches; this Mean is the ſide of a Square equal o the Triangle; then ſet 12 to the Length in eet, againſt this ſide is the Content.

If two ſides of a Triangle be equal, the unequal ſide may be the Baſe; if the three ſides be nequal, the longeſt ſide is commonly the Baſe; rom whence the neareſt diſtance to the oppoſite Angle is the Perpendicular.

PROP.

PROP. VIII.

Solids whoſe Baſes have many equal Sides and equal Angles.

Theſe Baſes are regular Figures: Having the Length in Feet, and a Side in Inches, get the Perpendicular from the Center to a Side alſo in Inches, ſo ſhall the mean Proportional between the Perpendicular and half the Sum of the Sides be the Side of a Square equal to the Baſe; which having found, meaſure it as ſquare Timber.

Example. A Piece of Timber of eight Sides is 10 Foot long, the Side 12 Inches, the Perpendicular 14.48 Inches, which you may call 14½; ſet 14½ to 14½, againſt 48, half the Sum of the Sides on the Line of Numbers, is 26.4 on the Square-line, or there make a Mark; then ſet 12 to 10, againſt this Mark is 48 Foot, and a little more than a quarter.

And thus much of theſe Ways of Timber-Meaſure, which being the main Occaſion of the Rule, and not depending on any thing which followeth, I have ſet in the firſt place.

PROP. IX.

Having the Girt, to find the Side of the Square equal near.

This and the two following Propoſitions are wrought on the double Scale, yet I have here adjoined them for their Affinity with Timber-Meaſure, and the proportional Numbers given in them are ready cut on the Rule, and give Contents to an Exactneſs ſufficient in any Concerns of Timber.

As 7. to 7.9, ſo the Girt to the ſide of the Square equal: let the Girt be 15 Inches, on the double Scale, ſet 7. to 7.9, againſt 15 is 16.9 near: If you ſet 12 to the Length in Feet, this Side ſhall point out a true cylindrical Content.

PROP. X.

Having the Girt, to find the ſide of the Square within near.

As 10 to 9, ſo the Girt to the ſide of the uare within near. *Example.* Set 10 to 9, a-inſt 15 is 13 ½; and ſo much will ſuch a Piece ar ſquare.

By which you may know, before a Piece be wn, how many whole Board or Plank, of any hickneſs, may be had out of it.

From hence alſo you may ſee, that the Girt, ' leſs than the ſide of the Square equal, yet is ater than the ſide of the Square within; to-rd which moſt Timber is hewn before it can ve to any ſquare Uſes; which may be one rea- of the continuance of the ſaid common Way; which Opinion I find alſo Mr. *Henry Philips* to in a Treatiſe on this Subject.

PROP. XI.

Having the Diameter, to find the Side of the Square within near.

As .1 to .707, or to excuſe a Cut there, as 8.5 6 (being Points equivalent near) ſo the Dia-ter to the ſide of the Square within near.

Let the Diameter be 19.1, *viz.* the Diameter 60 Inches Circumference; ſet 8.5 to 6, againſt .1 is 13.5 near.

PROP. XII.

find how many Inches in Length make a Foot olid, at any Girt or ſide of Square not exceeding 40 Inches.

Set the Girt or ſide of the Square on the uare-line to 1 at the beginning of the Line of mbers, againſt 41.57 are the Inches which ke a Foot.

So if you ſet 6, for Example, to 1, againſt 57 is 48, and ſo many Inches in Length make

a Foot at ſix Inches Girt or Side of Squ
And now having done with the Meaſure of
dinary Timber, let me advertiſe any Reader t
hath not ſeen much meaſured, that ſometimes
will find a great difference in the Girt of a T
in the ſpace of a Foot, more or leſs, for the m
part where one or more Arms have been cut
in ſuch caſe it is neceſſary to girt the Tree twi
yea thrice if there be cauſe, otherwiſe there w
be Loſs to Buyer or Seller.

Alſo they ſay, the Buyer hath Privilege to g
any where between the middle and the Grou
end, if it be for his Advantage.

P R O P. XIII.

True Meaſure of a Solid that tapereth ſtrai

Meaſure the Length in Feet; note alſo t
third part, which you may find by ſetting 3
the double Scale to the Length; againſt 1 is
third part. If the Solid be round, meaſure
Diameters at each end in Inches; ſubtract
leſs Diameter out of the greater; half the di
rence add to the leſs Diameter; the Sum is
Diameter in the middle of the Piece.

1. Set 13.54 to the Length, againſt the Dia
ter in the middle is a fourth Number.

2. Set 13.54 to the third part of the Leng
againſt half the difference is a fourth Numb
both theſe fourth Numbers added together m
the Content.

Exampl. Let the Length be 18 Foot, the th
part is *6*; let the greater Diameter be 24,
leſs 16, the difference is 8; half the differen
added to the leſs Diameter 16, the Sum 20 is
Diameter in the middle.

Set 13.54 to 18, againſt 20 is 39.27.

Set 13.54 to *6*, againſt 4 is .524, which added to 39.27, maketh 39.794, or 39 Foot and above 3 quarters.

Note, that 13.54 muſt be ſet to *6* in the ſecond gth, as in the ſecond Caſe of round Timber- aſure the common way.

f the Solid be ſquare, uſe the Sides of the ares at each end in every reſpect as the Dia- ers, meaſuring them in Inches, *&c.* but let 12 your firſt Number.

f it be any other regular Figure, uſe the Sides he Squares equal to each Baſe (found as is be- ſhewn) as the other, taking alſo 12 for your Number.

P R O P. XIV.

he Meaſure of a Shell or Flitch of Timber.

f a piece be taken out of the middle of a round e of Timber from end to end, there will be two pieces, which they call Shells or Flitches.

o find a near Content of theſe after the com- n way with little Trouble, meaſure the Length eet, the round part, and the Thickneſs in the dle (taken with a Pair of Calepers) in Inches. heſe two, with a third part of the Thickneſs, together, a fourth part whereof account your t, and meaſure as round Timber the com- n way.

f on the double Scale you ſet 3 to 4, againſt Thickneſs is itſelf, with a third part added t.

xample. Let the Length be 30 Foot, the nd part 25.3 Inches, the Thickneſs 7.2 Inches, 3 to 4, againſt 7.2 is *9.6*, which added to 25.3, keth 34*.9*, the fourth part whereof is 8.7 near.

r prick the ſaid *9.6* on the flat part in the ddle from one ſide, and keeping the end of r Line at the other, girt the whole round t, and to the ſaid prick; double the Line twice, meaſure it in Inches for your Girt.

et 12 to 30, againſt 8.7 is 15 Foot and three arters.

Note, That this holds not ſo well in Sectio cut far from the middle of the Piece; in othe it giveth a Content ſomewhat leſs than the co mon way, which may the better be born wi becauſe there is more Loſs in theſe than in oth Pieces; and as they fall ſhort of the middle Pie in Value, ſo a leſs exact Meaſure may ſerve.

PROP. XV.

Having the Diameter, to find the Area or ſupe ficial Content of the Circle.

Set 1 on the ſquare Line to .7854, or to exc a Cut there, ſet 11 to 9.5, againſt the Diame is the ſuperficial Content.

Example. Let the Diameter be 1.7 Foot, ſet to 9.5, againſt 1.7 is 2.27 Foot near.

By the Logs. to the Log. of the Diameter twice add this Log. 9.89509, being the Log. of the Decimal .7854, the Sum is the Log. of the ſuperficial Content.

1.7 .	0.230
	0.230
.7854	9.895
2.27	0.355

Note, That if the Diameter exceed not 3. 1 in the middle is but 1; but if it exceeds 3. 1 in the middle is 100.

Here you may have occaſion to make uſe of t Direction given in *Sect.* 5. *Part* 2.

Hence it is as eaſy, having the ſuperficial Co tent, to find the Diameter, or to caſt any Nu ber into a Circle, ſo may the Gauge-points be on, for they being the Diameters of Circles, wh Area's are equal to the Number of cubick Inch in the Gallon of Wine or Ale reſpectively, if y ſet the Rule as above, you will ſee the Wine-po ſtand againſt 231, and the Ale-point againſt 28

PROP. XVI.

Cask-Gauging.

The Figures of theſe Veſſels being uncerta the Staves of ſome being more circular from He

Bung, and ſo more capacious than other, the
e Gaugers diſtinguiſh them into four kinds;
e Sphæroid, whoſe Staves are moſt arching, and
s contains moſt; the Conick, whoſe Staves
m Head to Bung are ſtrait (if any ſuch can be
de) and this contains leaſt; the Parabola, whoſe
ves are arching, but nearer to the Sphæroid
n to the Conick; the Conoid, whoſe Staves
e arching, but nearer to the Conick than to
e Sphæroid; all theſe may have the ſame Di-
enſions of Length and Diameters, yet differ
nſiderably in the Contents.

Mr. *Everard* in his abſolute Piece, *Stereometry*
de eaſy, printed 1684, giveth a Diagram of all
e Kinds, and Rules for each, both by Arithme-
k and the Sliding-rule, except for the Conick,
ere being (as he ſaith) none ſuch made, yet
e Figure thereof is uſeful to the diſtinguiſhing
e other.

Mr. *Wingate* took no notice of theſe ſeveral
nds, his general Way applied to this Rule is
us:

Meaſure the Length of the Veſſel within, the
iameter at the Bung, and the Diameter at the
ead in Inches and Tenths; ſubtract the Diame-
r of the Head out of that at the Bung, the Dif-
rence multiply by 7, and divide the Product by
o on the Rule eaſily thus; on the double Scale ſet
o to the Difference, againſt 7 is the Quotient,
hich is 7 Tenths of the Difference.

Theſe added to the leſs Diameter, the Sum is
n æquated Diameter.

Then ſet the Gauge-point, whether of Wine
r Ale, to the Length, againſt the æquated Dia-
eter is the Content in Gallons.

Mr. *Everard* agreeth with Mr. *Wingate* upon
Tenths near for ten Inches difference of Diame-
ers, and accounts them to the Sphæroid; in

other differences of Diameters they differ mo

His Numbers for ten Inches difference are: f the Sphæroid 7·01, for the Parabola *6.39*, for t Conoid 5.*62*.

In other Differences the Rule differs ſomethi from his Table, to which I refer you.

To find the Content of a Cask in all th Kinds; let the Length be 34.5, the Diameter the Bung 29.4, that at the Head 25.3, this d ducted out of that at the Bung, the Remainder Difference is 4.1.

Set 10 to 4.1, againſt 7 is 2.87 for the Sph roid; againſt *6·39* or *6.4* is 2.*62* for the Parabol againſt 5.*62* is 2.3 for the Conoid.

Theſe added ſeverally to 25.3, the Sum is 28.1 for the Sphæroid, 27·92 for the Parabola, 27.6 fo the Conoid, for æquated Diameters.

Example. Set the Ale-point to 34.5, again 28.17 is 76.25 Gallons for the firſt; againſt 27.9 is 74.9 Gallons for the ſecond; againſt 27.6 73.2 Gallons for the third; ſuch is the differen (upon account of their Shape) by theſe Number

By the Logs. to this general Log. 7·53148 for Wine, to this 7.44484 for Ale, add the Log. of the Length and the Log. of the æquated Diameter twice, the Sum is the Log. of the Content, as you ſee here for Wine.

Gen. Log.	7·5314
34.5	1.5378
28.17	1.4497 1.4497
93·08	1.9688

The Fractions are thus reduced to Pints; o the double Scale ſet 10 to 8, againſt the Decim are the Pints anſwering

The Sphæroid may be known by the rou ſwelling of the Staves from one Head to anothe If you lay a ſtrait Rule on the Hoops of a Cas from the Head toward the Bung, and it touchet or very near, the Hoop next the Head, and th next the Bung, you may account it a Conoid;

th

e Rule librate upon the middle Hoops, like the
am of a Balance, and yet the Staves not much
elling, account it a Parabola.

Beſides the Shape of theſe Veſſels, I have ob-
ved two things, not noted by any to my Know-
ge, which may render the gauging them un-
tain; one is, the joining Staves of unequal
hickneſs, not taking care to ſmooth them with-
, which may cauſe an Error of ſome Tenths in
king the Bung Diameter.

The other this; the Head Diameter may be
ken too great, tho' taken without, by reaſon of
e paring away, and ſmoothing the inward ſide
the Cask at each end, in order to the putting
the Heads; ſo that in reaſon it ſhould exceed
e Diameter pointed out by the Staves, which is
e true Diameter: Both theſe I have ſeen in
sks that have been cut aſunder.

PROP. XVII.

Gauging and Inching of Tuns.

Theſe are of ſeveral Figures, but moſt are
uare or round.

The ſquare are either equal ſided or unequal,
th right-angled, and may be conſidered as the
me.

The round are either cylindrical, *viz.* having
e Diameters at top and bottom equal (if any
ch can be hoop'd) or conical, whoſe Diameters
the top and bottom are unequal.

Alſo the Content may be required, either total,
r only of ſome Liquor contained in them.

The Content is ordinarily found firſt in Ale
allons, which are reduced to Beer Barrels, by di-
iding the Number of Gallons by 36, or to Ale
arrels, by dividing the ſame by 32; alſo a Bar-
el containeth 4 Firkins; ſo 9 Gallons of Beer,
Gallons of Ale make a Firkin; the Dimen-
ſions,

ſions, *viz.* Lengths, Breadths, Depths and Di
meters, are taken in Inches.

SECT. I.

Square Tuns.

On the double Scale ſet 282 (cut on the Rules) to either Length or Breadth, againſt th other is the Content in Gallons at 1 Inch dee which being reduced to Firkins and Barrels, as i will bear, by a continual Addition, as we ad Pounds, Shillings, and Pence, a Table may b made to any Number of Inches deep.

Or if you ſet 1 on the ſaid Scale to any Dept in Inches of this Content, againſt the other i the total Content; or multiply them by the Pen.

Example. The Length is 84 Inches, the Breadth 62 Inches, ſet 282 to 62, againſt 84 in the firſt Length is 18.47 Gallons, or 2 Firkins, 2 Gallons, and near an half of Ale, which you may add, as in the Margin.

In.	*B.*	*F.*	*G.*	*P*
1	0	2	2	4
2	1	0	4	9
3	1	2	7	4
4	2	1	1	8
5	2	3	4	3
6	3	1	6	8
7	4	0	1	2

Let the Depth be 26 Inches, ſet 1 to 184 againſt 26 is 480.22, which is near a quarter.

By the Logs. To this gen. Log. 7.54975 add th Logs of the Length and Breadth, the Sum is th Log. of the Content at 1 Inch deep; and if t this you add the Log. of the Depth, the Sum the Log. of the whole Content; or if to the fai gen. Log. you add the Logs. of the Length, Breadth, and Depth, the Sum is the Log. of the whole Content, without notice taken of the Content at 1 Inch deep.

Gen. Log.	7.549
84.	1.924
62.	1.792
18.47	1.266
26.	1 414
480.2	2.681

Becau

Becauſe it is likely there will be Tenths of an h wet, on the double Scale ſet 10 to the Cont in Gallons at 1 Inch deep, againſt every tenth is own Share, or part of the ſaid Gallons. Let Tenths be *6*, ſet 10 to 18.47, againſt *6* is 11 llons, belonging to *6* Tenths. They put no ts into the Table.

SECT. II.

Cylindrical Tuns.

ving the Diameter of a cylindrical Tun in Inches, to find the Content in Ale-Gallons at 1 Inch deep.

If the Diam. exceed not 40 Inches, ſet the Aleint to 1 in the middle, againſt the Diam. is the ntent, 1 in the middle being one Gallon.

If the Diameter be above 40 Inches, ſet the d Point to 10 at the end, againſt the Diameter the Content, 1 in the middle being 10 Gallons.

Which Contents, being for 1 Inch deep, may firſt reduced, and then added continually for Table; or before it be reduced, multiplied by e Depth for a total Content.

Or ſet the Ale-point to the Depth, againſt the iameter is the total Content.

Example. Let the Diameter be 58 Inches, ſet e Ale-point to 10 at the end, againſt 58 is *9.37* allons, the Content at 1 Inch deep: let the epth be *36* Inches, ſet the ſaid Point to *36*, ainſt 58 is *337.3* Gallons; or multiply the Depth d Content at 1 Inch deep by the Rule or Pen.

Gen. Log.	7.44484
58.	1.76343
	1.76343
9.37	0.97170
36.	1.55630
337.3	2.52800

By the Logs. To the gen. Log. or Ale, add the Log. of the Diaeter twice, the Sum is the Log. f the Content at 1 Inch deep.

And if you uſe the Log. of e Depth, as in the former Setion, you will have the whole Content.

SECT. III.

Conical Tuns.

1. To find the whole Content; proceed as the meaſure of a Solid that tapereth ſtrait, *Pro* 13, only meaſure the Depth alſo in Inches, an inſtead of the Point at 13.54, uſe the Ale-poin as alſo the gen. Log. uſed in the Section ne above, which belongeth to it.

2. But in order to inching them; in ſmall on and Keelers they uſe only the Diameter in th middle, and account them as Cylinders; but in th larger they take one in the middle of every te Inches (beginning at the bottom) as alſo in th middle of the remaining Inches, except they b few, for then they account them to the laſt te and take the Diameter in the middle; theſe Te alſo they account as Cylinders.

3. Having found the Content anſwering th Diameter next the bottom, as is ſhewn *Sect.* 1 put it into Firkins and Barrels, as it will bear, an by a continual Addition (as in *Sect.* 1.) make u the ſaid ten Inches.

Then add the Content anſwering the next Di meter ſo reduced, Inch by Inch to the laſt Sum and ſo proceed till you have finiſhed.

4. In a regular Tun; having the Diameters a top and bottom, and the perpendicular Depth you may find any intermediate Diameter thus.

Divide the difference of Diameters by the depth the Quotient multiply by any diſtance from th greater Diameter, and ſubtract the Product from the ſaid Diameter, the Remainder is the Diame ter at that diſtance; or multiply the Quotient b any diſtance from the leſs Diameter, and add th Product to the ſaid Diameter, the Sum is th Diameter at that diſtance.

5. I

5. If the Tun be not exactly round, meaſure
o Diameters where you obſerve the Inequality;
d them together, and take the half; let the ſaid
o Diameters be the longeſt and ſhorteſt, which
ll croſs one another near at right Angles.

6. Becauſe moſt large Tuns are fixed, and that
ipping, for the better Deſcent of the Liquor,
e ſquare ones for the moſt part corner-wiſe,
d the Crowns or Bottoms of the round ones
mmonly uneven and irregular, I adviſe you to
up the ſaid Crowns or Bottoms, as alſo the
owns of Coppers, by Meaſure, till they be
holly covered.

Which may be done by a Veſſel of known
uantity, or you may gauge one or a Pail, or by
true Gallon, (for making which Directions are
ter given, which may alſo be otherwiſe ſer-
ceable) or in large Tuns beſt of all by both Veſ-
l or Pail and Gallon, uſing the Veſſel firſt, and
hen near covered, the Gallon.

7. When the bottom is covered, aſſign the gau-
ing-place (where the Water covers a whole Inch,
it may be; if not, make it up by Meaſure) and
x it by a Mark, and note the wet Inches; mark
lſo the Ends of the Diameters at the Superficies
f the Water, as alſo the Perpendicular, or near-
ſt diſtance of the top of the Staff from the Wa-
er, where the diſtance is leaſt, and the length of
he Staff from the Water in the ſame place, of
ll which having taken an exact Account, let out
he Water, and from the aforeſaid Marks begin
he Meſaure of your ſeveral 10 or 12 Inches, and
o the Quantity before meaſured in, add your
Contents Inch by Inch; the Content will be ex-
ct enough if you take a Diameter in the middle
of every 12 Inches.

8. Theſe ſeveral 10 or 12 Inches being under-
ſtood to be of the perpendicular Depth, to avoid

an Error, which in ſome Caſes may be conſid ble, on the double Scale ſet the perpendic Depth to the Length of the Staff, againſt Number of the ſaid Depth is the Number anſw ing on the Staff, which is always greater th that of the Depth.

9. The proportional Parts of any Content b longing to any Diameter, found as before, are t be ſet down, every Part againſt his own Tent in a Column by themſelves, againſt the Conten of the whole Inches, to be uſed for the Par which for the moſt part happen to be over a above the whole Inches.

10. Reduce not the Decimals of a Gallon (t Addition of them being eaſy, and becauſe th make not their Table to Pints) except in the pr portional Gallons.

11. The Diameters, whether long or ſhor are meaſured by Sliding-Rules, numbred in Inch as they are drawn out (or in Gallons, which wi ſave you ſome Trouble) and are made to ſet toge ther (ſo as to be portable) to a great Length.

What hath been ſaid of theſe Tuns, may b underſtood of Coppers, Coolers, or any othe Veſſels uſed for Wort, either round or ſquare.

12. In an oval Tun; find a mean Proportion between the longer and ſhorter Diameter, it i the Diameter of a Circle equal to the Oval.

13. As for a true Gallon; to any Diameter i Inches which you chuſe, find the Content in In ches (as *Prop.* 15.) by which divide 231 or 282 fo Wine or Ale reſpectively, the Quotient found t the hundredth part of an Inch, is the Depth. *Ex ample*, the Diameter is 6 Inches.

The ſuperficial Content anſwering is 28.27, by which dividing 231, the Quotient is 8.17, th Depth of the Wine Gallon, by which again divi ding 282, the Quotient 9.97 is the Depth of th Ale Gallon.

you would have it ſquare, divide the ſaid Numbers by the Square of the ſide in Inches; he ſide be 5 Inches, by 25 divide 231, the tient 9.24 is the Depth of the Wine Gallon; again by 25 divide 282, the Quotient 11.28 e Depth of the Ale Gallon.

PROP. XVIII.

To gauge a Stand.

may be accounted a cloſe conical Tun, and ſured as a Solid that tapereth ſtrait, *Prop*. 13. y (as in the conical Tun) meaſure the Depth in Inches, and inſtead of the Point 13.54, the Gauge-points, and the gen. Log belong- to them; as in this Example in Ale.

et the Depth be 33 Inches, a third part there- s 11; let the greater Diameter be 30 Inches, leſs 24 Inches, the difference is 6, the half erence 3, which added to the leſs Diameter, Sum 27 is the Diameter in the middle

. Set the Ale-point to 33, againſt 27 is *67* llons.

. Set the ſaid Point to 11, againſt 3 is .27, or ut a quarter of a Gallon; ſo the Content of Stand is *67.27* Gallons.

o little is the difference between the exact ntent and that found by the Diameter in the ddle.

PROP. XIX.

enlarge or diminiſh a Circle, Square, or other regular Figure at a Rate given.

The Proportion (reſpecting the Rule) is, as e Term of the Rate to the Square of the Dia- ter or Side given, ſo the other Term to the uare of the Diameter or Side required: there- e the Root thereof is the Diameter or Side manded.

Alſo if you would enlarge, the leſs Ter the Rate is firſt; if you would diminiſh, greater is firſt.

Example 1. If 1000 Men lodge in a Sq whoſe Side is 60 Paces, how many Paces the Side of a Square be wherein 5000 Men ſo lodge?

Here the ſecond Number being on the firſt moveable Rule, it is moſt convenient to ſet on the Square-line to 1000 in the middle of Line of Numbers, againſt 5000 on the Line Numbers is about 134, and ſo many Paces the Side be.

Example 2. I would diminiſh a Circle, wh Diameter is 10 Foot, at the rate of 8 to 5; 10 on the Square-line to 8 on the Line of Nu bers, againſt 5 on the Line of Numbers is Foot, the Diameter required.

PROP. XX.

Having the Dimenſions of the Parts of a Sh which make the Faſhion or Shape, together w the Burthen thereof, to find the Dimenſions the ſaid Parts for a Ship of any other Burth greater or leſs, retaining the Faſhion or Sh of the given Ship.

This Propoſition I find in Mr. *Norwood*, b wrought with great Trouble. Since the Inv tion of the Logarithms by the Lord *Nepa* (whoſe Name will never be forgotten) it is pe formed with great Eaſe, either by the Line Numbers, with a Cube line, being a Line of triple Radius adjoined, or moſt exactly by t Logs. for want of the aforeſaid Cube-line, ta this way by Compaſſes on the Line of Numbers.

Divide the Space between the Burthen giv and that required into three equal Parts, w th

Extent, ſet one Foot of the Compaſſes on of the ſaid Dimenſions.

the Burthen required be greater than the n, turn the other Foot forward to a greater ber; if leſs, turn it backward to a leſs Num- which ſhall be the Dimenſions required, *mple*, in Feet and Tenths.

e Burthen given	100 Tun.	Required 280 Tun.
	F.	F.
th of the Keel	50.5	71.2
th of the Midſhip-beam	21.	29.6
of the Hold	9.	12.7
g forw. of the Stem	13.5	19.
ng backw. of the Stern	4.	5.6

the Logs. Subtract the Log. of the leſs Bur- from the Log. of the greater, the Difference de by 3; the Quotient, or third Part, add to btract from the Logs. of the ſeveral Dimen- s of the given Ship, according as the Burthen ired is, greater or leſs than the given; the s or Remainders ſhall be the Logs. of the Di- ſions for the Burthen required.

his, holding in the Dimenſions of Maſts, ds, Cables, Anchors, &c. muſt needs be of t Uſe, being ſo eaſily wrought, eſpecially to Shipwright, it freeing him from groſs Error; by it he may be inſtructed to provide and or- his Materials to the beſt Advantage.

The ART of Practical Meaſurin Eaſily performed, &c.

PART IV.

The Uſe of the double Scale of Numbers in ſo ſuperficial Meaſures and Accounts.

Directions.

1. IN the Rule of Three direct. If the ſecon Number be greater than the firſt, the fou ſhall be greater than the third; and on the co trary.

But in the inverſe Rule, if the ſecond be grea er than the firſt, the fourth ſhall be leſs than t third; and on the contrary.

2. If ſetting the firſt to the ſecond, the thi reacheth beyond the Line, either remove the fi to the ſecond in the other Length of the ſeco Line, or take the third Number in the oth Length of the firſt Line.

3. The ſecond and third Numbers are nev taken both on the ſame Line.

4. Obſerve well what Number goeth with t Queſtion, for in the direct Rule, that of the oth two which agreeth with it in Name or Reſpe is the firſt, which you may ſet to either of t other.

As if the Queſtion be: If 32 Bricks pave o ſquare Yard, how many Bricks will pave Yards? Here 12 is the third Number, and 1 t firſt (both being of a Name) which ſet to 12 32, againſt the other is 384 Bricks; but for t oſt part the firſt Numbers are given, as you ill find after.

5. It is not hard to know the Value of the urth Number, for every Number on the Line creaſing or decreaſing in a tenfold Proportion, e nature of the Queſtion or the Thing meaſud will diſcover it; as in the Example above, the urth Number may be 384, or 38.4, or 3.84; but is evident that it cannot be either of the two tter, much leſs 3840: ſo is it in any other.

PROP. I.

Multiplication, 1 being the firſt Number.

Sect. 1. *The Square.*

Multiply the Side by itſelf; let the Side be 14 oot, ſet 1 to 14 (beſt in the firſt Length) againſt 4 on the firſt is 196 Foot. This is alſo found n the Square-line.

Sect. 2. *The long Square.*

Qu. 1. Multiply the longer Side by the ſhort. A Wall is 30 ½ Foot long, and 16 Foot high; t 1 to 16, againſt 30 ½ is 488 Foot.

Qu. 2. A Length is 42 Foot, the Breadth 0 ¾ oot; ſet 1 to 42, againſt the Decimal .75 is 31 ½ oot.

Q. 3. How many Men are in a Body, where ey ſtand 18 in Front, and 8 deep? Set 1 to 8, ainſt 18 is 144.

Sect. 3. *The Triangle.*

Multiply the Baſe and Perpendicular, the one hole by half the other, which you will In the ike-end of an Houſe, the over-way is 18 Foot, e diſtance from the Pike to the over-way (being the Perpendicular) 16; ſet 1 to 8, againſt 18 as before) is 144 Foot; or ſet 2 to either Perendicular or Baſe, againſt the other is the Conent.

Sect. 4. *The Trapezium.*

It is an irregular four-ſided Figure. An irregular Plot (as of Land) before the Content ca be found, is divided into theſe Trapezia an Triangles.

To find the Content, draw a Line from on Corner to his oppoſite one thro' the Trapeziu ſo as (if it may be) the two Perpendiculars fallin from the other two Angles upon this diagona Line (as they call it) may fall within the Trapezium, yet if one falls without, the Rule hold but then the ſaid diagonal Line muſt be produce far enough.

So have you two Triangles having one common Baſe; multiply this Baſe by half the Sum o the Perpendiculars, the Product is the Conten of the Trapezium; or ſet 2 to the Baſe; again the Sum of the Perpendiculars is the Content.

There is a Trapezium much uſed by the be Surveyors of Land, who, when they meaſur againſt a crooked Limit (be it Hedge, Ditch, o River) carry their Chain ſtrait from Mark t Mark, and taking Perpendiculars from the Chai to the Bents, Nooks, or Windings of the Limit deſcribe Trapezia's in their Plot, have each tw parallel Sides, and two right Angles.

The Content is found by multiplying half th Sum of the parallel Sides (being the Perpendiculars) by the neareſt diſtance between them, bein the intercepted part of the ſaid Chain-line; th Product is the Content.

So is meaſured any Trapezium which hath tw parallel Sides, tho' the Angles be not right; bu then one Side muſt be continued, if need be, fo this Line of neareſt diſtance muſt be perpendicular to the parallel Sides.

Thus may the Rhombus and Rhomboid b meaſured, and infinite others, neither æquilater nor æquangular.

Se

Sect. 5. *Any regular Figure.*

Whoſe Sides being equal, the Angles are alſo ual; multiply half the Sum of the Sides by the rpendicular let fall from the Center to one of e Sides.

Example. A Table hath *6* Sides, each Side 2 ot, the Perpendicular 1.73 Foot; ſet 1 to 1.73, ainſt *6* is 10.4 Foot.

Sect. *6.* *The Circle, and his Parts.*

1. The ſuperficial Content hereof is beſt found *Prop.* 15. *Part* 3. It is alſo found by multiply-g half the Circumference by the Semi-diameter.

2. For the Semi-circle, multiply half the Arch-e by the Semi-diameter.

3. The Sector, which is any Part contained be-een two Semi-diameters and the Arch-line, is o meaſured the ſame way.

4. If a ſtrait Line be drawn thro' a Circle, not ro' the Center, it divides the Circle into two gments; the Meaſure of the leſs is thus: Mea-re the Sector, whereof the Segment is a part, en ſubtract the Content of the triangular part, e Remainder is the Content of the Segment; t in the greater Segment the Content of the cluded Triangle muſt be added.

5. Having the Chord (*viz.* the ſtrait Line ove-mentioned) of a Segment, and the part of e Diameter intercepted between the Chord and e Arch, to find the whole Diameter.

As the intercepted part of the Diameter to lf the Chord, ſo the ſaid half Chord to the her part of the Diameter; add them, and you ave the whole.

6. The Diameter and Circumference are as 7 nd 22; ſet 7 to 22, againſt any Diameter is his ircumference; ſet 22 to 7, againſt any Circum-erence is his Diameter; or having ſet 7 to 22, gainſt the Circumference on the ſecond is the iameter on the firſt.

Sect. 7. *To reduce the aforeſaid Figures to Squares.*

Some of them, as the Triangle, long Squar *&c.* are reduced, as is ſhewn in the Meaſure o Timber of ſuch Baſes; the other, as alſo any i regular Figure, thus: Firſt find the ſuperfici Content, then ſet the Square-line to his Square as is before taught, againſt the ſuperficial Co tent on the Line of Numbers is the ſide of th Square.

PROP. II.

Diviſion, wherein the Diviſor is the firſt Numbe

Qu. 1. If 32 Bricks pave one ſquare Yard, ho many Yards will 500 Bricks pave? Set 32 to 50 or to 1, againſt the other is 15.*6* Yards.

Qu. 2. If 25 Trees coſt 21 *l.* what doth Tree coſt? Set 25 to 21, being neareſt, again 1 is 0.84 *l.* whereof the 8 is 16 Shillings, and th 4 is *9 d* ½, as you will after ſee.

Qu. 3. The Content of a Rectangle or lon Square being divided by one ſide (whether th longer or ſhorter) the Quotient is the othe Suppoſe 144 Men placed 24 in Front, how ma deep do they ſtand? Set 24 to 144, againſt 1 *6*.

PROP. III.

The Rule of Three direct.

Sect. 1.

When the Length is meaſured in Feet, th Breadth in Inches, and yet the Content require in Feet, 12 is the firſt Number, marked as 12 o the Square-line, chiefly for the Meaſure of Plan or Board, and Glaſs.

Qu. 1. A Plank is *36* ½ Foot long, 18 Inch broad; ſet 12 to either Length or Breadth, here to 18, being neareſt, againſt *36* ½ is *54* ½ Foot.

Qu. 2. A Board is 14 Foot long, 26 Inches road; ſet 12 to 14, againſt 26 is 30 $\frac{1}{3}$ Foot.

Qu. 3. A Pane of Glaſs is 2 $\frac{1}{4}$ Foot long, 7.6 ches broad; ſet 12 to 7.6, againſt 2 $\frac{1}{4}$ is 1.42 oot, which .42 is almoſt an half.

Sect. 2. *Sawyers Meaſure.*

They account 120 to the Hundred. If you ould know the Content of a Stock of Plank or oard in ſuch Meaſure; having found the Con-ent of one Plank or Board by the Section afore-oing, ſet 120 (repreſented by 12) to the ſaid ontent, or to the Number of Karſes or Cuts which are always leſs by one than the Number f whole Boards in the Stock) againſt the other re the Sawyers Hundreds, which will fall in the cond Length, except there be not 100 Foot in e Stock. The Tenths are each of them 12 oot.

Example. Admit there were 22 Boards in the tock mentioned *Qu.* 2. of the foregoing Section, e Content of one Board is 30 $\frac{1}{3}$; ſet 12 to 21, e Number of Karſes, againſt 30 $\frac{1}{3}$ is 5.31 near.

Which is 5 hundred and 37 Foot; for every enth being as is ſaid 12 Foot, if you ſet 10 to 2, againſt 31 is 37 and more.

Sect. 3. *Glaſs.*

It is moſt convenient in Glaſs to meaſure the ength as well as Breadth in Inches; yet the Con-ent being required in Feet, 144 (repreſented by 44) is your firſt Number, and the Content, if whole Foot, or above, in the ſecond Length, s next before.

Example. A Pane of Glaſs is 31 $\frac{1}{2}$ Inches long, $\frac{1}{2}$ broad, ſet 144 to 8 $\frac{1}{2}$, againſt 31 $\frac{1}{2}$ is 1.86 Foot.

Let there be 7 ſuch Panes, ſet 1 to 1.86, a-ginſt 7 is 13 Foot.

Sect.

Sect. 4. *By the Yard.*

In the following Queſtions both Length and Breadth are to be meaſured in Foot-Meaſure. If the Content be required in Yards, 9 is the firſt Number, there being 9 ſquare Feet in a ſquare Yard. So they meaſure Painting, Paving, Plaiſtering, Wainſcot, *&c.*

Example. A Length is 24 Foot, the Breadth 10 ½; ſet 9 to 10 ½, againſt 24 is 28 Yards.

Sect. 5. *By the Square of* 10 *Foot, as in Tiling, Flooring,* &c.

Here 100 is the firſt Number. A Roof is 41 Foot long, and the Sparr 20 ½ Foot; ſet 100 to 41, againſt 20 ½ is 8.4 Squares.

Sect. 6. *By the ſquare Rod, at* 16 ½ *Foot to the Rod, as in Brick-walls.*

Here 272 ¼ (being the Square of 16 ½) is the firſt Number; alſo 272 being cut on theſe Rules, may ſerve without conſiderable Error. A Wall is 110 Foot long, 9 ½ Foot high; ſet 272 to 110, againſt 9 ½ is 3.83 Rod in the ſecond Length. If you would have a Mark at 324, the Square of 18, ſet 18 to 10, againſt 18 on the ſecond mark the Point.

Sect 7. *By the Acre.*

In Land-Meaſure 160 ſquare Perches, Poles, or Rod (commonly at 16 ½ Foot, in ſome places 18 Foot to the Pole) make an Acre, therefore 160 (repreſented by 16) is the firſt Number; the Parts are 40 Pole to the Rood or Quarter, 80 to 2 Roods, 120 to three; the Lengths and Breadths are meaſured in Poles.

Examp. 1. A Length is 35 Perches, the Breadth 19; ſet 160 to 19, againſt 35 is 4.15 Acres.

Example 2. A triangular Piece of Land hath the Baſe 24 Poles, the Perpendicular 16 ½; ſet 160 to 16 ½, againſt 12 (half the Baſe) is 1.24 Acre near; or ſet 320 to the Baſe 24, againſt the Perpendicular 16 ½ is 1.24, as before.

PROP.

PROP. IV.

The inverſe Rule.

Here the Number that goeth with the Queſtion is the firſt Number, which you may ſet to ither of the other.

Example. It ſeems 272 ¼ Foot make a Rod of Brick-wall only at 1 ½ Brick Thickneſs, if it be hicker, fewer Feet anſwer a Rod, if thinner, hen more, at an inverſe Proportion.

If it be demanded how many Feet anſwer a Rod (for Example) at two Brick Thickneſs,

Set 2 (which goeth with the Queſtion) to 1 ½, gainſt 272 ¼ is about.204, *viz.* 204 18 Foot; and o for any other Thickneſs, which may be mark- d for firſt Numbers thus: ſet 1 ½ to any Thickneſs, againſt 272 ¼ on the ſecond mark the Points.

PROP. V.

Fractions.

By Fractions I mean Decimals; a general Rule or them is: Set 10 or 100 to the Number of Parts (that make the whole) in the Queition, gainſt every Decimal is its own Share or Por- ion of the ſaid Parts.

Sect. 1. *Of a Pound Sterling.*

The firſt Figure after the Prick in any Decimal of a Pound, is ſo many two Shillings, double t therefore, and you have the Shillings anſwer- ng; 5 in the next place is one Shilling; theſe eing accounted, ſet 100 to 24, againſt the remaining Decimal are the Pence; if there be not in the ſecond place, having ſet as above, againſt he other is the Pence, the Farthings being very aſily eſtimated on the Rule.

Example. Let .688 be the Decimal, the *6* is 2 *s.* and 5 in the next 8 is 1 *s.* ſet 100 to 24, gainſt 38, the remaining Decimal, is *9 d.* in all 3 *s.* *9 d.*

Or without the Rule thus: Having taken ou the Shillings, as above, if the remaining Decima exceed not 30, account them Farthings, abatin one; if it exceed 30, take 25 out of it, which i 6 *d.* and the Remainder account Farthings, abating one.

Note, That the Decimal is ſuppoſed of thre places at leaſt; if it be but of two, ſuppoſe a Cypher for the third; and if there be more, yo may neglect them, with the Caution in the lik Caſe before given.

So taking .25 out of .38 (in the Example above) the remaining 13 account 12 Farthings, o 3 *d.* ſo the whole is 9 *d.*

Sect. 2. *Of a Rod.*

At 30 *s.* the Rod, what are 28 Cents? Set 10 to 30, againſt 28 is 8.4, *viz.* 8 *s.* and 4 tenths; ſe 10 to 12, againſt 4 is 4 *d.* ¾; in all 8 *s.* 4 *d.* 3 F.

Sect. 3. *Of an Acre.*

How many Perches are 15 Cents of an Acre Set 100 to 160, againſt 15 are 24 Perches. Mor Examples are needleſs.

Sect. 4. *Vulgar Fractions into known Parts.*

Set the Denominator, being the lower, to hi Numerator, againſt the Number of known Part in the whole is the Number of Parts required; o ſet the Denominator to the Number of Part againſt any Numerator is his Portion of the ſai Parts.

How many Farthings are $\frac{5}{7}$ of a Shilling? Set to 48, againſt 5 is 34, or 8 *d.* 2 Farthing.

Sect. 5. *Vulgar Fractions into Decimals.*

Set the Denominator to his Numerator, again 100 is the Decimal required. What Decimal of Foot is $\frac{7}{12}$ or 7 Inches? Set 12 to 7, againſt 100 .58 near enough, or .583.

The aforegoing Examples being well underſtood, it will not be difficult to apply the doub Scale to any other Subject.

The ART of
ractical Meaſuring
Eaſily performed, &c.

PART V.

SECT. I.

The diagonal Scale. (Fig. III.)

T conſiſteth of 21 equidiſtant parallel Lines thorough the length of the Scale, and of tranſ-rſe Parallels at a quarter of an Inch diſtance one om the other, with 5 Diagonals thorough the ppermoſt Integer. In the Parallel of 10 there a Cypher at every Tranſverſe. This Row of yphers divides the whole Scale into two Scales, ving one diagonal Integer over both.

It is fitted chiefly to *Gunter*'s Chain, which is counted the beſt for ſurveying of Land, and is 16 Perches in the Inch.

If the place of Tens in the Links be 0, 2, 4, 6, 8 (the laſt four whereof are ſet againſt their ſpective Diagonals) uſe the firſt or Left-hand ale; but if the place of Tens be 1, 3, 5, 7, or 9, e the ſecond or Right-hand Scale; for that iagonal which is 20 (for Example) in the firſt, 30 in the ſecond; that which is 40 in the firſt, 50 in the ſecond, &c.

Example 1. Let 10 Chains and 46 Links be quired from the Scale, ſet one Foot of the ompaſſes on the long Parallel or Link-line, re-eſenting 6 in the 10th Chain-line or Tranſverſe, d firſt Scale, and extend the other to the Dia-nal 40 in the ſaid Link-line of 6.

2. But to take off 10 Chains and 56 Links, one Foot on the Link-line of 6 in the ſaid ten Chain-line, and ſecond Scale, and extend the oth to the ſame Diagonal in the ſaid Link-line of ſo have you the Lines required.

3. So having a Line on your Plot, to kno how many Chains and Links it is, take it wi your Compaſſes, and carry it parallel to the Lin lines, one Foot in one of the Chain-lines, a the other thorough the diagonal Integer, till falls on one of the Diagonals, and according it falls in the firſt or ſecond Scale, ſo account t Tens of your Links.

The Scale may be made to 20 in the Inch (it is commonly to 12, and ſet on the other ſid which muſt needs exceed any plain Scale of th Dimenſion for Exactneſs.

Sect. 2. *Gunter's Chain.*

It is 4 Perches long, at $16\frac{1}{2}$ Foot to the Perc theſe make 792 Inches; it hath 100 Links, each Link is 7.92 Inches.

Thoſe Chains Mr. *Warner* ſells are diſtinguiſ ed with pieces of Braſs at every tenth Link, whi pieces contain ſo many Corners or Points as th ſignify Tens of Links from either end of t Chain; as thus: that Braſs at 10 Links has o Tippet or Point, that at 20 has two, that at 3, that at 40, 4; and the ſame again from t other end; but at 50, the middle, is a large rou piece of Braſs; and at 25, from each end, tw Curtain-rings together. By the help of theſe D ſtinctions (which are plainer, and far more viſib than the old way of Rings alone) you will ſpe dily find the Number of Links.

Altho' the Chain be divided into 4 Perches the two double Rings and the large Braſs Circ in the middle, ſo that it may be applied to t

Meaſu

aſure of any Length by the Pole, yet in mea- ing Lengths in ſurveying we take notice only Chains and Links, not concerning ourſelves h Perches till we caſt up the Content.

To multiply a Length and Breadth meaſured h this Chain, reduce them into Links, which o more Trouble than to ſet the Links at the ght-hand of the Chains; or if there be no ks, to put two Cyphers there; ſo 4 Chains d 32 Links are 432 Links, and 7 Chains are o Links.

Having multiplied a Length by a Breadth, the th Figure of the Product to the Left-hand (if re be ſo many) is Acres compleat, the ſeventh ens of Acres.

Example 1. If you multiply 5 ains and 82 Links by 3 Chains d 21 Links, the Product is 86822, whereof the 1 is one re.

```
Ex. 1.    582
          321
          ———
          582
         1164
        1.746
      ———————
      1 86822
```

Alſo 13 Chains and 42 Links 8 Chains and 70 Links, the oduct is 11.67540, whereof the is eleven Acres. The Deci- als are reduced to Roods and rches as followeth.

```
Ex. 2.    13.42
            870
          ———————
          93940
         10736
        ———————
       11.67540
```

ſt. 3. *To reduce the decimal Links of* Gunter's *Chain into Poles.*

An Acre is 160 ſquare Perches, as hath been d, equal to 100,000 ſquare Links of this Chain, hich being divided by 160, the Quotient 625 is e ſquare Links of one Perch or Pole; this, as is the Decimal of an Acre, ought to be expreſ- d thus .00625, as alſo all other, *viz.* with 5 places,

ces, except it be even Tens, for a Cypher or C phers at the Left-hand are of no value, as ha been ſaid.

The Parts of an Acre are firſt 4 Roods, whe fore 4 is your firſt Multiplier, and there being Pole in a Rood; 40 is your ſecond.

Or if you multiply your Decimal by 160, t Figures remaining to the Left-hand, after t Decimal be cut off, are Perches immediately.

But where the Content is not exacted to hal Pole, we uſually take this ſhorter Courſe, wi out prefixing Cyphers.

It is evident, that if the places of the Decim be but three, there cannot be two Poles; if th be four, multiply the firſt Figure by 6; if fi multiply the two firſt places by 6, in both ſet t Product one place back toward the Right-han then add together the firſt, or two firſt pla (reſpectively) of the Decimal and Product ſo ſ adding alſo a Unit for every 6 that ſhall be in t Figures of the next place, the Sum is the Nu ber of Poles in the Decimal.

See here two Examples, one of 4 places, the other of five; alſo you ſee how the Products are placed and added.

Ex. 1. *Links* 81
48
Poles 13

In the firſt there is once 6, in the ſecond twice 6, in the Figures of the next place, for which 1 in the firſt, and 2 in the ſecond, are added to the other; the two places to t Right-hand are neglected, as never amounting the ſixth part of a Pole.

Ex. 2. *Links* 217
126
Poles 35

The reaſon of this Operation, Mr. *Wing* (in whoſe Arithmetick I firſt met with it, u alſo by Mr. *Atwell*, as you may ſee in his Bo of Surveying printed *Anno* 1662, which I va

beyo

yond moſt Books of that Subject printed ſince)
eming it not very obvious, leaves to the Search
the Curious. Take it here:

1. If 100 (which are ſo many thouſand ſquare
nks being an Acre) require 60 to be added to
to make it 160 Poles, being alſo an Acre, what
ll any other Number of thouſands of ſquare
nks require to be added to it to turn it into
les?

2. To multiply a Number by 6, and divide the
oduct by 10, gives the ſame Quotient which
u have by multiplying the ſame Number by 60,
d dividing the Product by 100.

3. Setting the Product a place back to the
ght-hand, both divides by 10, and ſeats it for
ddition.

Sect. 4. *A ready and exact way by the Rule.*

On the double Scale ſet 100 to 16, againſt the
nks are the Poles anſwering; neglect the two
ſt Figures, as is ſaid.

If the Decimal be 60,000 or more, take 5 out
the firſt Figure, accounting for it 2 Roods,
d find the Poles anſwering the Remainder; let
e Decimal be .82511, deducting 5, the Remain-
r is .32511; ſet 100 to 16, againſt .325 is 52,
iz. 1 Rood and 12 Pole; ſo the Decimal is 3
ood 12 Pole.

Sect. 5. *Having the three ſides of a right Line Triangle, to find the ſuperficial Content.*

Add the three ſides together, from half the
m ſubtract each ſide ſeverally, ſo you have three
emains; multiply theſe three Remains and the
lf Sum continually, that is, the firſt Remain by
e ſecond, that Product by the third, and this
roduct by the half Sum, the ſquare Root of this
ſt Product is the ſuperficial Content.

Moſt eaſily and ſpeedily by the Logs. thus: Ad the Logs. of the three Remains and the half Su together, half the Sum is the Log. of the ſuperf cial Content.

Example. Let the Sides be 1050, 854, 774, th half Sum is 1339, the three Remains 289, 485, 565, the Content is 3 Acres, 1 Rood, and 1 Perch near: This is the moſt certain way of meaſuring Land, where the Triangles can be meaſured in the Field; which otherwiſe are firſt plotted, and then caſt up by the Baſe and Perpendicular, as hath been ſhewn.

1339	3.126
289	2.460
485	2.685
565	2.752
a.	11.025
3.25640	5.512
150	*a. r. p.*
41	3. 1. 01 *ne*

DIREC

DIRECTIONS IN DIALLING.

PART VI.

CHAP. I.

he Uſe of a Diagonal Scale, in laying down Angles, with the help of the Natural Sines, or for want of them, the Artificial or Log-Sines, applied to the putting the Hour-points on large Plains.

THE moſt convenient Scale for this Purpoſe is that of 100 Parts in the Inch. If you ſuppoſe he Spaces between the long Parallels divided each nto ten Parts, they are Milleſms, or thouſand arts, which are the leaſt that can be taken off he Scale; they are commonly made a Foot long, nd have on them ten Inches, beſides the diagonal ne diſtinguiſhed.

Alſo account the Radius or Sine of 90°.00′ to e 10.0000, ſo the firſt Figure of all the Sines bove that of 5°.44′. will be an Integer, that, and l under it to the Sine of 0°.34′ Decimals of the rſt Rate; that, and all the reſt, except the Sines f the three firſt Minutes, of the ſecond, and thoſe f the ſaid three of the third.

The

The general Rule is,

As the Semi-radius, the Sine of 30°.00′, 5.00
To the Semi-diameter;
So the natural Sine of the half Arch
To the Chord of the whole.

Multiply the Sine of the half Arch and the S midiameter, and prick off the Decimal in t Product; then for the Diviſion by 5.; double t ſaid Product, and prick off one Figure more the Decimal; this is the Chord.

Example. For the Chord of 40°.00′ to a Sem diameter of 12 Inches; the Sine of 20°.00′. *vi* 3.4202 multiplied by 12, the Product is 41.042 this doubled, and one place more prick'd off, 8.20848, or 8 Inches, and 208 Parts, which m be taken off the Scale for the Chord aforeſai the two laſt Figures may be neglected.

If your Semidiameter be not limited, it is do with far leſs Trouble; for if you take 5 for yo Semidiameter, the Sine of the half Arch is t Chord; if that be too little, multiply 5 by a Number, and by the ſame multiply the Sine the half Arch, the Product is the Chord. *Exam* For the Chord of the ſaid 40°.00′. to a Semidi meter of 30 Inches, that is ſix times five, mul ply the ſaid Sine of 20°.00′. 3.4202 by 6, the Pr duct 20.5212 is the Chord; the laſt Figure m be neglected.

Note, That altho' you take only three plac of Decimals from the Scale, yet in Multiplicatio for a larger Semidiameter it is beſt to take four.

If the Minutes of the Arch, whoſe Chord yo ſeek, be odd, add half of the Difference of t Sines of the two Minutes, between which t half Arch falls, to the Sine of the leſs Minut the half Difference you may find by view, wit out writing.

If you have not the natural Sines, you may
d them by ſeeking the Log. Sines in the Table
Logs. of natural Numbers; the correſpondent
mber is the natural Sine, with this Direction:
the Index of your Log. Sine be 9, the firſt Fi-
re is an Integer; if 8, then the Number is a
cimal of the firſt rate; if 7, then of the ſe-
d, *&c.* which is eaſily remembred.

CHAP. II.

rections in the Uſe of the Tables of Logs. of Sines, Tangents, and natural Numbers, in order to the putting on the Hour-lines, and ſetting up the Stile in the moſt uſeful Plains.

The Log. of the Radius, *viz.* the Sine of 90°.
Tang. of 45°. is 10.00000; therefore to add
e Radius to a Log. Sine or Tang. (for only ſuch
e here meant, tho' called barely Sines or Tan-
nts) is to make the Index of it ten more than it
; to deduct or abate the Radius, is to make the
dex ten leſs than it is.

1. In the Canons or Rules following; if the
ſt be the Radius, add the Logs. of the ſecond
d third; the Sum (a Radius deducted) or near-
t to it, found in the Tables, gives the Sine,
angent, or Number ſought.

2. If the ſecond or third be the Radius, add
em together, out of the Sum deduct the firſt,
e Remain, or neareſt to it, gives the fourth;
r rather add the Ar. Compl. of the firſt to that
f the other two, which is not the Radius; the
m of both gives the fourth.

Note, That the Tang. Compl. or Cotang. is
e Ar. Compl. of the Tangent, omitting the Ra-
ius, and is always in the ſame Rank with the
Tangent in the other Column, or in the other
ge, according as the Tables are ordered.

3. If none of the three be the Radius, add t Ar. Compl. of the firſt to the other two; t Sum of all three gives the fourth.

4. If there be many Proportions to be wrough and the firſt and ſecond, or the firſt and thi (which in this Caſe account the ſecond) hold a ways the ſame; if the firſt be the Radius, wri the ſecond in a piece of Paper at the top ne the edge, the Figures equal to thoſe of the T ble you uſe, and holding it under the third Nun bers in the Table, add them in a Column in ano ther Paper.

5. If the ſecond or third be the Radius, wri the Ar. Compl. of the firſt, and uſe it in eve reſpect as before.

6. If none of the three be the Radius, wri the Difference of the firſt and ſecond ſo, an holding it to the other, add, if the firſt were th leſs, but deduct if the ſecond were the leſs: if you had rather add, write the Ar. Compl. the Difference, and add it.

7. If the ſecond and third hold the ſame, wri the Sum of them at the bottom of a piece of P per near the edge, and holding it over the fir Numbers in the Table, deduct the ſaid fir Numbers.

There are alſo Proportions where the Nun bers are figurate, whereof here followeth an E ample in finding the Hour and Azimuth.

But whereas in theſe there are ſometimes Sid or Angles above 90°, ſo that the Complement t 180 muſt be uſed in their ſtead, I adviſe you (fo ſaving that Trouble) to write the Degrees abov 90 on the top of the Table, in the Left-han Column or Page, near the printed Degrees; a near gr. 0 write 90, near gr. 1 write 91, near g 10 write 100, and ſo the reſt in order, as far a you think you may have occaſion, always obſe

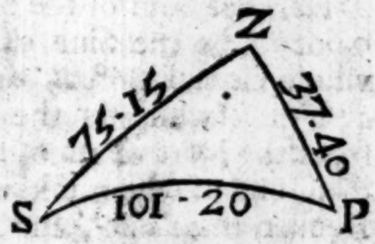
vin

ng that you uſe the Minutes under the ſaid itten Degrees, but the Sines themſelves take the other Column, or in the other Page, be- g the Complements of theſe; ſo if you would e the Sine of 91° 20′ in *Gellibrand*'s Tables, ſeek e 20′ under gr. 1, but take the Sine againſt it the Right-hand Page, *viz.* 9.999 88, the Sine 88° 40′, as alſo of 91° 20′.

CHAP. III.

ving the Latitude of the Place, the Declination and Altitude of the Sun, to find the Hour and Azimuth.

N the Triangle Z P S repreſenting the Zeth or Point over head, e Pole, and Sun; the e Z P is the Compl. the Latitude, Z S the ompl. of the Alt. S P e diſtance of the Sun om the Pole, which in the Summer half Year the Compl. of the Declination, but in the Win- r half Year is his Declination with 90 Degrees dded; alſo the Angle at P is the Hour, that at Z e Azimuth.



Let the ſides be as in the Ex- ple, and the Hour enquired; dd the ſides; from half the Sum ke the ſide oppoſite to the en- uired Angle, and note the diffe- nce.

To the Ar. Compl. of the Sines f the ſides comprehending the quired Angle, add the Sines of e half Sum, and of the diffe- nce; half the Sum is the Co-ſine or Sine Compl. f half the enquired Angle.

	° ′
	101.20
	75.15
	37.40
S.	214.15
H. S.	107.07
	75.15
Diff.	31.52

The half Sum of the Sines, *viz.* 9.96268, you will find to be the Sine of 66° 35′, whoſe Compl. 23° 25′ doubled is 46° 50′; this turned into Time, is 3 Hours and 7 Minutes from Noon; that is, 7 Minutes before 9 or after 3.

.213
.008
9.980
9.722
19.925
9.962

Note, That 15 Degrees make an Hour, a
15 Minutes of a Degree 1 Minute of Time.

For the Azimuth in this Example; the half Sum is the ſame, but another ſide being deducted, there is another difference.

H. 107
101.
D. 5

Half the Sum of the Sines, *viz.* 9.60290, is the Sine of 20° 37′, whoſe Compl. 66° 23′ doubled, is 132° 46′, which is the Azimuth from the North Part of the Meridian, out of which taking 90, the Remain is 42° 46′, and ſo many Degrees the Sun was paſt the Eaſt-point, or ſho
of the Weſt, at the time of that Obſervation.

.213
.014
9.980
8.997
19.205
9.602

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CHAP. IV.

To find the Declination of a Plain.

Alt. Degr.	*Refr. Min.*
0	31
1	23
2	17
3	14
4	12
5	11
6	10
7	9
8	8
9	7
10	7
11	6
12	6
13	5
14	5
15	4
16	4

IN order to which take this Table of the Refraction of the Sun Minutes, corrected by the Paral- x, as far as 16° Alt. the Uſe is: ke the Minutes againſt the De- ees, each out of his reſpective De- e, ſo have you his Alt. free from efraction: Alſo it is not uſual to ke any Obſervation in this Caſe er 10, or before 2 of the Clock.

2. Take a Board that hath a ſtrait e, on a Center in a Diameter pa- el to that Side, and about half an h or more from it, deſcribe a Se- ircle, divide it into two Qua- nts, each Quadrant into 90, and divide it as you think fit, num- it with 10, 20, 30, *&c.* from h end of the Diameter to 90; al- it may be convenient to number Degrees on either ſide of 90 double, that is, 80 ſet 100, at 70, 110, *&c.* the part without Semicircle may be cut off.

3. Apply the ſtrait ſide to the Plane, ſo as the perficies thereof may be exactly horizontal or el; hang a Thread with a Plummet ſo as it y caſt a Shadow on the Center; when the Sha- w is on the Center, mark the Degree cut by it the Semicircle; at the ſame time let another e the Altitude of the Sun with a Quadrant or her Inſtrument.

4. Having found how many Degrees the Sun is ort of or paſt the Eaſt or Weſt Point, ſet off

that Point which is on the Plain backward or f
ward reſpectively from the Degree cut by t
Shadow or Point, the Degrees intercepted b
tween the Diameter and the ſaid Point are t
Degrees of the Declination of the Plane, whi
is either Eaſt or Weſt, according to the Point th
is on the Plane.

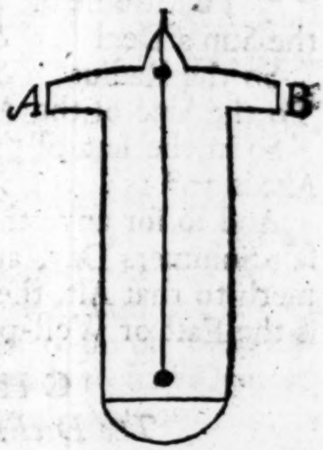
5. It may be convenient in ſome Caſes to
off the South-point from the Degree cut by t
Shadow, by the Compl. of the Azimuth to 1
then 90 Degrees forward or backward will be t
Eaſt or Weſt-point.

Note, That inſtead of the Semicircle divid
on the Board, it may be more convenient (at le
for Carriage) to have one ſo divided upon f
Paper or Paper Royal, for then any Board h
ving a ſtrait ſide, and a Line drawn near and p
rallel to that ſide, being applied to the Wall,
above, you may direct the Shadow any wh
toward the middle of the ſaid ſtrait ſide; and
the time of Obſervation of the Alt. of the S
make two Pricks in the Line of Shadow, the o
diſtant from the other as far as conveniently y
can, then taking the Board from the Wall, jo
the ſaid Points in a Line drawn at full leng
and apply the Center of your Semicircle in t
Point of Interſection of the Line of Shadow wi
the parallel Line on the Board, and the Diamet
exactly on the ſaid parallel Line, ſo the Line
Shadow will ſhew the Degree to be uſed in e
ry reſpect as in *Paragr*. 4. of this Chapter; y
may take two or more Obſervations, but then
careful to apply the Azimuth each time to
proper Degree in the Semicircle.

Otherwiſe.

Upon a Board of about 8 Inches broad, exac
planed, let a Semicircle of about 7 Inches ſem

meter be drawn, and divided, as above; let a
ſs Index about an Inch broad be fitted to turn
on a Pin in the Center, having a Point in the
iddle of the end, which may move round juſt
the Diviſions or amongſt them.



Let the End be as the Fi-
re in the Margin, the di-
nce from A to B two In-
s at the leaſt.

From the Point let a fi-
cial Line be drawn tho-
ugh the Center, and near
Point in the ſaid Line
there be a Hole for a
all Thread or Luteſtring,
llowed underneath for
Knot of the ſaid String.

Fix another Rule to this, of about ſix Inches
g, and the Breadth of the other, at a right
gle, a little behind the Center, with Screws,
an ordinary Sight is fitted to the Index of a
in Table.

Placing it on the Center, and the Point at 90,
gn a Point in the top, which muſt be equidi-
nt from either End of the Diameter, or from
y two Points therein equidiſtant from the Cen-
, thro' this Point drill a Hole, and thro' it
w a fiducial Line down to meet the other
ne.

Let this Rule have a Notch in the ſide near
bottom, for a Plummet to be hung from the
, whereby the Board may be placed horizon-

Strain a String thro' both the Holes, and the
ard being ſo placed, turn the Index to the Sun,
the Shadow of the String fall into the fiducial
ne of both Rules; and the Degree pointed,
te as before, &c.

CHAP.

CHAP. V.

To find what Altitude the Sun hath when he due Eaſt or Weſt.

AS the Sine of the Lat. ° ′
To the Sine of *Sine of* 52.20 *Ar. Com.* 10
the Sun's Decl *Sine of* 23.30 9.600
So the Radius *Sine of* 30.15 *the Alt.* 9.70
To the Sine of the Alt.

So in the Lat. of 52° 20′ and Decl. 23° 30′
Alt. is 30° 15′.

And ſo for any other Lat. and Decl. If it b fair Summers Day, and you wait till the Sun meth to that Alt. the Degree cut by the Shad is the Eaſt or Weſt-point.

CHAP. VI.

The Declination of the Sun.

THE Sun's place in Degrees and Minutes every Day at Noon is in all Ephimerides, a in ſome Almanacks yearly, from whence his ſtance from the next Æquinoctial Point be known, his Declination is found by this Can

As the Radius
To the Sine of the Sun's greateſt Decl. 23° 3
So the Sine of his diſtance from the next Æq noctial Point,
To the Sine of his Declination.

But in caſe thoſe ſhould be wanting, I h ſubjoined Tables of his Declinat. for every Day Noon for 4 Years together, with the Years o them, as they are in Sir *Jonas Moore*'s new Syſt of the Mathematicks, which will hold for ſo Years forward; and for their further Conti ance I have adjoined a Table of Seconds, tal out of Mr. *Wright*'s Correction of Errors in N vigation, by the help of which they may be re fied, ſo as to ſerve for many Years to come.

CHAP. VII.

find the *Aſcenſional Difference, or the Time of the Sun's riſing or ſetting from Six.*

S the Cotang. of the Lat.	*Cotang. of* 52°.20′ *Ar. Compl.*	.11241
the Tang. of the Sun's Decl.	*Tang. of* 23.30	9.63830
the Radius	*Sine of* 34.17	9.75071
the Sine of the Aſcenſional Diff.		

So in the Lat. of 52°.20′ and greateſt Declina-n, the Aſcenſional Difference is 34° 17′, which time is 2 H. 17 M. wherefore the earlieſt Hour-is that of a quarter before 4, and the lateſt a rter after 8, which ought to be on the Dials that Lat. except they be made to half Quarters Minutes, as ſome horizontal Dials are.

CHAP. VIII.

The horizontal Dial.

S the Radius
To the Sine of the Lat.
the Tang. of the Hour in the Table following
To the Tang. of the Arches of the Hour-line from the Meridian.

Write the Sine of the Latitude, as is before di-fied, and holding it under the Tangents of the urs, add them in a Column againſt their own urs; ſeek them, or the neareſt among the ngents, the Degrees and Minutes anſwering the ſaid Arches or Arks of the Plane, which down in another Column, every one againſt own Tang.

Draw a Line on the Plane for the Meridian, or r of 12, and the Subſtylar; in it chuſe a Cen-, out of which deſcribe an occult Circle, in ich ſet off the ſaid Arks of the Plane from the

Meri-

Meridian on either ſide, which may be done by a Line of Chords, or a Protractor (theſe Dials being for the moſt part ſmall) or by a ſmall diagonal Scale, as is before ſhewn. Lines drawn from the Center thro' theſe Points ſhall be the Hour-lines.

The Hour-line of *6* croſſeth the Meridian in the Center at right Angles; and the Hour-lines before *6* in the Morning, and after *6* in the Evening, may be ſupplied, by continuing their oppoſite Hour-lines beyond the Center to the oppoſite ſide.

The Style muſt be put up in the Center over the Meridian at an Angle equal to the Latitude of the Place.

Theſe are commonly made in Braſs, and the Style is a Braſs Plate, which being of a conſiderable thickneſs, the two Edges caſt the Shadow, each on the Hours next it; ſo the Dial is in two parts ſeparated by a Space equal to the thickneſs of the Stile; but note, that the Shadow is caſt upon the continu'd Lines before and after *6*, from the oppoſite Edge of the Stile, whereof care muſt be taken.

The

A TABLE

Of the equal Diſtan
of the Hours in D
grees and Minut
from 12 *for the h*
rizontal and ver
cal Dials, from
for the Eaſt a
Weſt Dials, bei
the Angles at t
Pole.

12	0	6
.	3 . 45	.
x	7 . 30	x
.	11 . 15	.
11.1	15 . 0	7.
.	18 . 45	.
x	22 . 30	x
.	26 . 15	.
10.2	30 . 0	8.
.	33 . 45	.
x	37 . 30	x
.	41 . 15	.
9.3	45 . 0	9.
.	48 . 45	.
x	52 . 30	x
.	56 . 15	.
8.4	60 . 0	10.
.	63 . 45	.
x	67 . 30	x
.	71 . 15	.
7.5	75 . 0	11.
.	78 . 45	.
x	82 . 30	x
.	86 . 15	.
6	90 . 0	12

The Dials following are ſuppoſed to be made pon Board or Plank with Lead and Oil, and to e fixed after they are made; the Stile a round ron Rod.

It is beſt to prime them on both ſides together, nd to hang them ſo as a ſmall Gale may turn the ides ſucceſſively to the Sun, otherwiſe they may e drawn from the Exactneſs to which they ught to be made: paint them thrice.

CHAP. IX.

The Eaſt and Weſt Dial.

THere is no difference in the making of theſe two; the Hour-line of *6* is the Subſtylar, hich muſt croſs the Æquinoctial-Line of the lain at right Angles.

This Line muſt be drawn at full length, and he Shape of the Dial ought to be an Oblong, raher than a juſt Square.

The Hour-points may be prick'd in the Æquioctial-Line from the natural Tangents of the ours in the Table, taken from a diagonal Scale, n either ſide from *6*, *viz.* on the upper ſide acording to the aſcenſional difference, on the lowr ſide to 11. or 1, they are ſeldom put on furher, for the great diſtance of the other quarters, d 12 cannot be put on.

If the natural Tangents be wanting, they may e found in the Table of Log. Numbers, as is bere directed for the natural Sines.

The Style muſt be parallel to the Subſtyl. the eight in this caſe as the Tang. of 45, *viz.* 10, hich is alſo the diſtance of *9* and *3* from the ubſtyl. the Hour-lines are all parallel to the Hour f 6, and ſo to one another, the Æquinoctial-line utting them all in the middle.

This Line muſt be croſied ſomewhere by an ccult Line at an Angle equal to the Lat. which in the fixing muſt be a Perpendicular or Plum line (it pointing to the Zenith, from whence t Æquinoctial is diſtant according to that Angl by means whereof the Æquinoctial-line of t Plain will be adjuſted to the due Height.

If the Plain be a fixed Plain, this Vertical, Pe pendicular or Plumb-line, muſt be firſt drawn help of a Thread and Plummet, and then t Æquinoctial-line at the ſaid Angle, and then t Subſtyl. and the other Hour lines, as before.

But in large Plains, to proportion the diſtan of the Hour-lines and the Style to the Plain:

As the Sum of the natural Tangents of 75 and of the aſcenſional difference,

To the Length of the Æquinoct. Line in Inch

So the natural Tang. of the aſcenſional differen

To the diſtance of the Hour-point of *6* fr the upper-end of the Line.

And ſo is 10 to the Height of the Style.

In the Lat. above-named, the natural Tang. of the aſcen. diff. is 6.817, that of 75° 37.32, the Sum 44.137; let the Æquinoct. line of the Plain within the Border be 32 Inches, the diſtance of the Hour point of

44.137	*Ar. Compl.*	8.355
32.		1.505
6.817		.833
4.942		.693
44.137	*Ar. Compl.*	8.355
32.		1.505
10.		1.
7.25		.860

6 from the upper-end of the ſaid Line will be 4 Inches and the height of the Style and diſta of the third Hour 7.25 Inches. Then,

As the Tang. of 45° to the height of the St

So the Tang. of the Hours in the Table longing to this Plain,

To their diſtance from the Subſtyl. which ther into a Table, as is directed in the horizon Dial.

T

The further Hour-lines from the Subſtyl. ought be longer than the nearer, or the Style of a ſuf-ient Length, leſt the Shadow thereof at ſome ne or other of the Day or Year goeth off the lain. This Dial muſt be ſet in the Plain of the eridian.

CHAP. X.

he prime Vertical, or full South upright Plain.

Lacing the Dial as it muſt be fix'd, or if it be fix'd, draw a vertical Line for the Meridian, Hour of 12, and the Subſtylar. toward the up-er part chuſe a Center, where croſs the ſaid Line right Angles with the Hour-line of 6.

As the Radius to the Coſine of the Lat. ſo the angent of the Hour in the Table to the Tan-nt of the Hour-line from the Meridian.

Which having gathered into a Table, out of e Center deſcribe an occult Semicircle, and in-ribe theſe Arches (as you will be directed in the xt) from the Meridian on either ſide.

The Style muſt be put up in the Center over e Meridian at an Angle equal to the Compl. of e Latitude, for which you will have large and ain Directions afterward.

CHAP. XI.

he vertical Decliner, or the upright declining Plain, the South Face.

N making this moſt uſeful Dial, after the De-clination found,

1. We enquire the Inclination of the Meridian the Plain to that of the Place.

As the Sine of the Lat. to the Radius, ſo the ang. of the Plains Declination to the Tang. of e Inclination of the Meridians, which aſſigns e place of the Subſtyl. among the Hours.

2. The Height of the Pole above the Plain.

As the Radius to the Coſine of the Lat.
So the Coſine of the Decl. to the Sine of ſaid Height, which is the Height of the St above the Subſtylar.

3. The diſtance of the Subſtyl. from the Meridian.

As the Radius to the Sine of the Declination
So the Cotang. of the Lat. to the Tang. of the diſtance.

Look into the Table of Hours for vertical Dials. If the Inclination of the Meridians be any of the Degrees and Minutes in the Table, whether whole Hour, half, or quarter, write the Figure or Mark thereof reſpectively in the middle of a half Sheet of Paper, near the Left-hand ſide, in a narrow Column, and write againſt it *Mer. Subſtyl.* then fill up the Column upward and downward with the Hours, Halves, and Quarters, as they ſtand in the Table, to ſix Hours each, with this Direction; if the Declination be Eaſt, place the Morning Hours; if Weſt, the Evening Hours about the Subſtyl. As in this Example, where the Inclination falls on the half Hour paſt 10, the Decl. being Eaſt.

In another Column againſt the Quarters, above and below *Mer. Subſtyl* write 3.45, againſt the next 7.30, and ſo the reſt, as in this Table; theſe are the Angles at the Pole.

	&c.
.	48.45
x	45.0
.	41.15
I	37.30
.	33.45
x	30.0
.	26.15
12	22.30
.	18.45
x	15 0
.	11.15
11	7.30
.	3.45
x	*Mer.S*
.	3.45
10	7.30
.	11.15
x	15.0
.	18.45
9	22.30
.	26.15
x	30.0
.	33 45
8	37.30
.	41.15
x	45.0
	&c.

the Incl. falls not on a quarter, down *Mer. Subſt.* as before, in e middle,and continue the quar- s between which it falls,upward d downward, to 6 Hours, in ſuch arrow Column.

Take the quarter in the Table Hours next leſs than the Incl. t of the ſaid Incl. the Remain againſt the ſaid quarter in ano- r Column; then take the Re- in out of 3.45, this Remain ſet inſt the quarter on the other e of *Mer. Subſt.* in the ſaid Co- nn.

By a continual addition of 3° to theſe Remains, make up h Row towards 90, not above; e are the Angles at the Pole. the ſecond Example, where Incl. is between three quarters t 2, and 3 the Decl. Weſt.

n the continual addition of , ſhorten your Work thus; d only thrice above and thrice w, ſo you have the four firſt arters on each ſide; then to the t add 15 Degrees (for the Mi- tes alter not) then to the ſe- d, and ſo to the reſt, which u may do by Inſpection, ſo have 2 Hours on each ſide; then inning again, add 30 Degrees the firſt, and continue your addition of 30 in der, till it amounts to 90, not above; this is ſo y, as you may account it as faſt as you can ite.

	&c.
.	53.25
x	49.40
.	45.55
12	42.10
.	38.25
x	34.40
.	30.55
1	27 10
.	23.25
x	19.40
.	15.55
2	12.10
.	8.25
x	4.40
.	0.55
	Mer.Sub.
3	2.50
.	6.35
x	10.20
.	14.05
4	17.50
.	21.35
x	25.20
.	29.05
5	32.50
.	36.35
x	40.20
.	44.05
6	47.50
.	51.35
	&c.

Having the Angles at the Pole,
As the Radius.
To the Sine of the height of the Style;
So the Tang. of the Angle at the Pole
To the Tang. of the Arks of the Plain fr

the Subſtyl. to the Hour-points. To attain whi take the Courſe directed in the horizontal D by writing the Sine of the Height, *&c.*

Set down the Tangents, every one againſt own Angle, in another Column.

In a fourth ſet down the Degrees and Minu anſwering theſe Tangents; theſe are the Ark the Plain.

In order to the finding the Chords belongi to theſe Arks, in a fifth Column ſet down Halves of theſe Arks; if the Degrees be odd, down the leſs half, and add 6 to the place of T in the Minutes, and then halve them.

If the Minutes of the whole be odd, note it the half, by annexing 5 at the Right-hand of Minutes.

In a ſixth, the Chords to the Semidiameter

In a ſeventh, the ſaid Chords multiplied to a other Semidiameter, according to the Largeneſ the Plain, and as you have uſe of them.

Ex. Of a Plain declining Eaſt 12° 45′. Lat. 52°

	°	′		
Sine of	52	20	*Ar. Compl.*	.101
Tang. of	12	45		9.354
Tang. of	15	57	*Incl. Mer.*	9.456
Coſine of	52	20		9.786
Coſine of	12	45		9.989
Sine of	36	35	*height of the Pole*	9.775
Sine of	12	45		9.343
Co-Tang. of	52	20		9.887
Tang. of	9	40	*diſt. of Subſt.*	9.231

P

Part of the Table on each ſide the Subſtyl.

ur.	An. Pol.	Tangents	ArkPl	H. Ark	Co. for 5	For other.
.	34.42	9.61561	22.26	11.13	1.9452	
I	30.57	9.55316	19.46	9.50	1.7078	
.	27.12	9.48615	17.02	8.31	1.4810	
I	23.27	9.41251	14.30	7.15	1.2620	
.	19.42	9.32919	12.03	6.015	1.0495	
12	15.57	9.23131	9.40	4.50	.8426	
.	12.12	9.11012	7.21	3.405	.6409	
I	8.27	8.94715	5.04	2.32	.4420	
.	4.42	8.69020	2.49	1.245	.2457	
11	0.57	7.99489	0.34	0.17	.0494	
er.	Subſtyl.					
.	2.48	8.46461	1.40	0.50	.1454	
I	6.33	8.83526	3.56	1.58	.3432	
.	10.18	9.03468	6.11	3.055	.5393	
10	14.03	9.17363	8.29	4.145	.7395	
.	17.48	9.28184	10.50	5.25	.9440	
I	21.33	9.37176	13.15	6.375	1.1530	
.	25.18	9.44983	15.44	7.52	1.3687	
9	29.03	9.51989	18.19	9.095	1.5916	
.	32.48	9.58444	21.01	10.305	1.8237	
I	36.33	9.64525	23.50	11.55	2.0649	

To draw this Dial.

Placing it as it muſt be fix'd, draw a Vertical or mb-line in or near the middle (if the Declinat. re great, leave moſt Space on the Subſtyl. ſide) the Meridian.

In this Line near the top chuſe a Point for the nter, and draw an Arch out of it at as large a nidiameter as the Plain will bear.

In this Arch ſet off the Subſtyl. from the Me- lian on the Left-hand, the Decl. being Eaſt (but Weſt, on the Right) and draw it at full length ro' the Center and this Point.

Suppoſe this Semidiameter 35 Inches, the Ch
in the Table againſt 12 (which is always the ſa
with the diſtance of the Subſtyl. from the Me
dian) is .8426, which multiplied by 7 (for ſo m
ny times 5) the Product 5.8982 taken off
Scale (the laſt Figure neglected) and prick'd do
in the ſaid Arch on the Left-hand of the Me
dian, giveth the Point, thro' which and the C
ter the Subſtyl. muſt be drawn.

From this Point ſet off the Chords, multipl
reſpectively, in the ſaid Arch on either ſide
the Chord exceed not 11 Inches, it is on the Sca
but for the greater, open the Compaſſes to
Inches, and ſet as many of the ſaid Diſtances
the Meridian Line from the Center as it will be
and note or account them 10, 20, 30, *&c.*
when any Chord is above 10, 20, 30, *&c.* ta
the Exceſs off the Scale, and ſet it down in t
Line from the Point which it exceeds, and w
a Pair of large or Beam-Compaſſes take the wh
Line from the Center to this Point; when
Chords go off the Plain, take a Semidiameter
Inches leſs.

Note, It is moſt convenient to ſet off the S
ſtyl. from the Meridian at as large a Semidian
ter as the Meridian-Line will bear, by the f
Direction in the firſt Chapter; but the Ho
points at as large a Semidiameter of Fives as
ſaid Line will bear at firſt, and then leſs.

There ought to be no Hour-lines above the
rizontal Line, that croſſeth the Meridian at ri
Angles in the Center, in the South Faces of th
Plains, altho' ſome Points on the Subſtyl.
reach beyond it; but there being always a Bor
at the top, and the Semidiameter ſmall, you m
perhaps ſet off a Point or two above it, and dra
ing a Line from them beyond the Center, h
their oppoſite Points. But take a general Rule

Ta

Take the half Arks of the uppermoſt and low-
Quarters in your Column, each out of 45;
Sum of the Remains add to the laſt half Ark
that ſide that wants; ſeek the Chord, multi-
it (if there be cauſe) and ſet it off from the
bſt. as before; if more be wanting, take the
ference of the laſt, and laſt ſave one, on the
bſtyl. ſide, add it to the laſt Sum, and find the
hord, &c. and ſo proceed, by taking the diffe-
nce between the two next, adding it to the laſt,
d finding the Chord, till all be ſupplied.

Having put on the Points, you may deſcribe the
rder; draw alſo two Lines parallel to the Bor-
r, the inmoſt for the half Hours, the other for
Quarters, at convenient Diſtances.

Then you may deſcribe a large Semicircle out
the Center for the whole Hour-lines. If the
clination be ſo great, as it cauſed you to ſet the
ridian near one ſide, let it be an Arch greater
n a Quadrant, or as far as about the middle
tween the Meridian and the Border, and draw
Line from the end thereof parallel to the Meri-
n, up to the above-mentioned horizontal Line;
o croſs the Subſtyl. in the Center at right An-
s with a ſhort Line.

Pierce the Center perpendicular to the Plain
th a tapering Bit, till the Diameter of the Hole
equal to the Breadth of your Hour-line; fill
Hole with a round Peg, that may be about a
arter of an Inch above the Plain, and thereon
g a fine Thread or Luteſtring by a Nooſe ſo
ge, as it may turn round on the Peg; ſtretch
s String juſt over the Hour-points, and with a
ir of dividing Compaſſes opened to the Breadth
the Hour-line, make two Pricks near the Bor-
, intercepting the Thread juſt in the middle,
d ſquare to the ſaid Thread.

Then laying a Rule to the Peg and the Poi anſwering, draw the Line from the Semicircle the Border for the whole Hours, but for t Halves and Quarters, only from their reſpecti Lines, and ſo go round; then turn the Rule t other way, and applying it to the anſwering Poi draw the other ſide of the Line in the ſame ma ner; then fill it with ſome Colour.

CHAP. XII.

To find what Hours the Sun ſhineth on the Nor Face of any upright Plain.

1. IF the Face be direct North,
As the Tang of *Tang.* 52°.20′ *Ar. Com.* 9.887
the Lat. *Tang.* 23.30 9.638
To the Tang. *Coſ.* 70.23 9.525
of the Sun's greateſt Declination;
So the Radius
To the Coſine of the Hour from the Meridia
in which the Sun is due Eaſt or Weſt.

In the Lat. of 52° 20′ the Time is 18′ after 7 the Morning, and as many before 5 in the Ev ning. The Morning Hours before, and the Ev ning Hours after, muſt be on the Plain.

2. If the Plain declines:
As the Cotang. of the Sun's greateſt Declinatio
To the Cotang. of the Lat;
So the Coſine of *Cotang.* 23.30 *Ar. Compl.* 9.638
the Inclination of *Cotang.* 52.20 9.887
the Meridians, *Coſine* 15.57 9.982
To the Coſine *Coſine* 71.10 9.508
of an Angle, which added to that of the Incli tion, the Sum turned into Time, is the Hour a Minute from Noon, in which the Sun leaves t Plain before Noon, or comes on it after No (as the Plain reſpects the Eaſt or Weſt) for t fewer Hours; the Difference is the Time,

abo

bove, for the more Hours. The Morning Hours efore, and the Evening Hours after, muſt be on he Plain.

In the Example of the Plain before-mention'd, he Declination of the South Face being toward he Eaſt, the North Face is toward the Weſt, herefore the more Hours are after Noon; the um is 87° 07′. The Sun in the longeſt Day aves the Plain 12′ after 6 in the Morning, the ifference is 55° 13′, therefore he comes on it gain 19′ before 4 after Noon; wherefore the Hour-line of 6, and all before, muſt be on one ide; and a quarter before 4, and all after, on the ther.

3. If the Declination of the Plain be greater han the Amplitude in the greateſt Declination, he Sun ſhines on the Plain only before Noon, r only after Noon reſpectively. The Amplitude the diſtance, in Degrees and Minutes of the Horizon, of the Sun's riſing or ſetting from the aſt or Weſt Points, and is thus found:

s the Coſine	*Coſine of* 52°.20′ ***Ar. Compl.***	.21391
f the Lat.	*Sine of* 23 . 30	9.60070
o the Radius	*Sine of* 40 . 44 ***Ampl.***	9.81461

o the Sine of the Sun's Decl.

To the Sine of the Ampl. So in the Lat. of 52° 0′ and greateſt Decl. the Ampl. is 40° 44′.

In theſe North Faces the Style points upward. n a direct North Plain, draw firſt an occult or bſcure vertical Line thro' the middle of the Plain, r the Meridian and Subſtyl. croſs it at right Anles, lower than the middle, with the Hour-line f 6; the Interſection is the Center; the Hournes are drawn as in the South Face; the Hours hat fall below 6 muſt be drawn from their opoſite Lines, continued beyond the Center, as in he horizontal Dial.

The Morning Hours are on the Right-hand the Meridian, when the Dial is placed as fix' the Evening on the Left.

In the North-eaſt Faces, the Afternoon Ho in the Table of Hours muſt be ſet above and b neath *Mer. Subſt.* and ſo continued upward a downward, and the Subſtyl. on the Right-ha of the Meridian, when the Dial is placed, as abov In the North-weſt Faces the contrary in both ſpects.

In the greater Decliners more Space muſt left on the Subſtyl. ſide, and care muſt be tak to leave ſufficient Space for the Hours that f below the Center.

When the Declination of the Plain exceeds t greateſt Amplitude, the inſide of the Border m be the Meridian.

CHAP. XIII.

Directions for great Decliners.

IN both Faces of theſe upright Plains, the gre ter the Decl. is, the nearer the Hour-lines f together.

Where they fall ſo near together as you c ſcarce diſtinguiſh them, it is beſt to leave out t Center.

Wherefore draw the Dial at large upon Pap or Paſtboard; if it be for a ſmall Dial (as in Pain of Glaſs) ſet off alſo the Style, according its due Height, on one ſide of the Subſtyl. ſo yo may cut out as much thereof in a Square or O long as will fit your Deſign, and prick it dow upon your Plain, and ſet the Stile up at the Heigh anſwering the Part cut off, without more Tro ble than to draw an occult Line parallel to th Meridian in any place convenient (before you c it out) for the due placing thereof.

Bu

But for a large Plain, it is beſt to draw the Dial By two Tangent Lines, as followeth.

In your large Draught above-mentioned you may omit moſt of the inward Hours, and the Trouble belonging to them, more than the Tangents of the Arks of the Plain.

Deſcribe a ſmall Square, the ſide parallel to the Meridian, in a convenient place in your Draught, which may contain all or moſt of the Hour-lines and the Subſtyl.

Let the large Draught be ABDE (*Fig.* IV.) the ſmall Square G H D F, within this ſmall Square draw two parallel Lines perpendicular to the Subſtyl. ſo as they croſs all the Hour-lines, and yet e diſtant one from the other as far as the Square will permit, *viz.* OP and QR.

Meaſure the ſide of the ſmall Square, and the Length of the Subſtyl. from the Center to the Points of. Interſection with both theſe Lines; theſe Lengths are Semidiameters, and the croſs Lines Tangents to them.

Meaſure alſo the neareſt diſtance of the Point f Interſection of the Semidiameter and Tangent artheſt from the Center, from each ſide of the quare next to it, as NI and LI.

Example.

Lat. 52° 20′ Decl. Weſt 82° 30′ the ſide of the mall Square 8 Inches .4 the Semidiameters CI and CM 17 Inches .2 and 12 Inches 16 diſtance of I om FD, *viz.* LI 3 Inches .46, the diſtance theref from HD, *viz.* NI 2 Inches, the ſide of the lain, whereon the Dial is to be drawn, within e Border, ſuppoſed a Square 32 Inches. As the de of the little Square to the ſide of your Plain, o the Length CI to the larger Semidiameter of our Plain; and ſo the Length CM to the leſs midiameter of your Plain; and ſo the Diſtances

LI and NI to their anſwering reſpective Diſtanc
in your Plain.

To find which the neareſt way, take the diff
rence of the Logs. of 8.4 and 32, *viz.* .58087, a
add it to the Logs. of the third Numbers, t
Sum ſhall give the Length of the Lines belon
ing to your Plain, according to the 6th Directio
Cap. II. the Semidiameter CI will be 65.53, Sem
diameter CM 46.32, the diſtance LI 13.18, a
the diſtance NI 7.62, alſo the difference of t
Semidiameters, *viz.* the Line MI is 19.21 Inches

Coming now to your Plain, fix the Point I a
cording to his own diſtances, wherein there is
need of Exactneſs.

Thro' it draw an occult Vertical anſwering
KL. Out of I as a Center, and as large a Semid
meter as the Plain will bear, deſcribe an occ
Arch of a Circle from the Vertical on both ſid
in it inſcribe the diſtance of the Subſtyl. from t
Meridian, and draw the Subſtyl. at full length th
I and this Point; ſet off the Complement of t
diſtance on the other ſide of the Vertical, to ma
up a right Angle; draw a Line at full length th
this Point and the Center I, it ſhall be the gre
er of the two Tangents..

From I ſet off the difference of the Semidiam
ters in the Subſtyl. toward the Center of the D
to M, thro' this Point draw the leſs Tangent
rallel to the other.

As the Tang. of 45
To the Length of each Semidiameter,
So the Tang. of the Ark of the Plain
To his reſpective diſtance of the Hour-po
from the Subſtyl. And,
So the Tang. of the Height of the Style
To his reſpective Height above the Subſty

Theſe you may obtain with much Eaſe a
Speed, by holding the written Log. of each Sen

meter to the Tangents of the Arks of the
in before found, and adding them, &c. accord-
to the firſt Direction, *Cap.* 2. Having gather-
theſe Diſtances into 2 Columns againſt their
pective Tangents, ſet them off from the Sub-
l. in their proper Tang. Lines, and join the
ints with Lines, continuing them beyond the
nts to the Borders.

Then ſet up the Style over the Subſtyl. at the
o Heights aſſigned, or rather chuſe another
int in the Subſtyl. nearer to the Center, and
d the Height anſwering by the Length of the
midiameter to it, and ſet it up accordingly.

The Directions of Mr. *Gunter*, concerning theſe
at Decliners, being very ſhort, I have made
em as plain as I can, and by the help of the
iagram they are freed from the Dfficulty which
ithout it would have attended them.

CHAP. XIV.

irections in putting up the Style in Dials that have their Centers on the Plain.

THis depending on the Solution of a right-line
Triangle, it will not be amiſs to premiſe the
ual Canons whereby it is reſolved, noting firſt,

1. That in every right-line Triangle the three
ngles are equal to two right ones, or 180 De-
ees; therefore if one Angle be known, the
m of the other two is known; and two being
own, all are known.

2. In a right-angled Triangle, the right Angle
ing 90°, the other two are Complements, each
the other; therefore if one be known, the
ther is alſo known.

3. The greater Side is always oppoſite to the
eater Angle, and on the contrary.

Prop. 1.

Prop. 1.

In a right-angled Triangle, if you make eith ſide next the right Angle the Radius, the oth is the Tang. of his oppoſite Angle. Therefore,

As the Tang. of 45°
To the known ſide,
So the Tang. of the Angle oppoſite to the e quired ſide
To the enquired ſide.

Prop. 2.

In a right-angled Triangle, if you make t ſide oppoſite to the right Angle the Radius, t other Sides are the Sines of their oppoſite Angl Therefore,

As the Radius
To his oppoſite ſide,
So the Sine of either of the other Angles
To his oppoſite ſide.

Prop. 3.

In any Triangle the ſides are proportional the Sines of their oppoſite Angles; therefore t Angles and one ſide known:

As the Sine of any Angle given
To the oppoſite ſide,
So the Sine of either of the other Angles
To his oppoſite ſide.

So having two ſides, and an Angle oppoſite either of them, the other Angles may be foun and the third ſide.

Prop. 4.

In any Triangle having two ſides, and the A gle comprehended by them, to find the other t Angles, and the third ſide.

As the Sum of the ſides
To their difference,
So the Tang. of half the Sum of the unkno Angles

To the Tang. of half their difference.

The Sum of the half Sum and half difference the greater Angle, and their difference is the ſs. Having all the Angles, the third ſide may found by the *Prop.* next before.

Prop. 5.

Having the three ſides, to find the Angles.

As the Baſe, the greater ſide,
To the Sum of the other ſides,
So the difference of the other ſides
To a fourth Number, which being taken out the Baſe, the Perpendicular will fall on the iddle of the Remainder, ſo you have two right-gled Triangles, in each two ſides known, and e right Angle oppoſite to one of them, from hence the other Angles and the third ſide may found by the ſecond part of *Prop.* 3.

A far better way, after the manner of finding e Hour and Azimuth before delivered.

From half the Sum of the three ſides deduct ch ſide ſeverally.

To the Ar. Compl. of the Logs. of the half m, and of the difference of the ſide oppoſite to y enquired Angle, add the Logs. of the other o Differences; half the Sum is the Log. Tang. half the enquired Angle; then you may repeat e latter part of the Work for one of the other gles, or find them both by *Prop.* 4.

To put up the Style.

1. Add 90° to the Height thereof, protract that gle, and let one end of the Style be turned as ar as you can to it; this turned part muſt not full ſo long as the Dial is thick, let it be ſome-hat tapering, with a Skrew at the end, and a ut fitted to it, to be let in to the Back of the ial; let the other end be rounded to a blunt int.

2. For the due Length of the Style, as relat to the Hour, take the Length of the long Hour-line on the Subſtyl. ſide of the Plain fr the Center to the inner Border, whether it whole Hour, half, or quarter, to the tenth of Inch (which is ſufficient in this Caſe) and n the Angle at the Pole belonging to it.

As the Radius
    To the Coſine of the Angle at the Pole;
So the Cotang. of the Height of the Style
    To the Tang. of a firſt Angle.

The Shadow of the Style being ſhorteſt in greateſt Winter Declination of the Sun, on South Faces of theſe upright Plains, but in greateſt Summer Declination in the North Fa add 23° 30′ to this Angle, the Sum is a ſeco Angle.

As the Coſine of 23° 30′
    To the Sine of the ſecond Angle;
So the Length of the Hour-line
    To the Length of the Style.

Note, If the Sun be beneath the Horizon the Hour belonging to the longeſt Hour-li find the Declination of the Sun anſwering aſcenſional difference of the ſaid Hour, by a co verſe of the Canon, *Cap.* 7. *viz.* As the Rad to the Sine of the aſcenſional difference, ſo Cotang. of the Lat. to the Tang. of the Declin

This Declination uſe in every reſpect as y are directed to uſe the greateſt, and you ſh have a ſhorter, yet ſufficient Length of the Sty

3. Aſſign a Point in the Subſtyl. at a conve ent diſtance from the Border, wherein to fi Supporter. Then by *Prop.* 1.

As the Tang. of 45°
    To the Length of the Subſtyl. from the Ce ter to this Point,
So the Tang. of the Height of the Style

To the Length of the Supporter; to which ſt be allowed more for the greater part of the ye or Hole in which the Style muſt reſt (which y be ſomewhat oval) alſo muſt be allowed at other end near as much as the thickneſs of Plank, for fixing it; the part to be driven in the Dial let be ſquare, ſtrong, and a little taing, but not to a Point, with a Shoulder above for the driving it; let it be made of good Iron, newhat ſlender toward the Eye, that it may bent or wreſted any way for the due adjuſting Style.

4. Draw or raze a ſhort Line in the middle the Style on each ſide, which may point ſtrait at the turned end.

5. Having pierced a Hole for the Supporter, e it near to its Depth, put the Style thro' it, ſink the turned end into his place at the Cen, till the razed Lines before mentioned fit exly to the ſhort Line, directed to be drawn thro' Center perpendicular to the Subſtyl. *Cap.* 11.

6. But to adjuſt it to the true height and place, the juſt Length of it from the Center; then *Prop.* 2.

s the Radius
To the Length of the Style,
o the Coſine of the Height
To the diſtance of the Point in the Subſtyl.
n the Center, perpendicularly under the end
the Style. And
o the Sine of the Height
To the diſtance of the end of the Style from
ſaid Point.

7. In the largeſt Arch of the Plain, ſet off at a venient equal diſtance two Points, from the nt of Interſection with the Subſtyl.

8. If the Style be ſo placed that the end there or (where the Style is long) a Point marked

in the middle of the upper ſide thereof (near p pendicular to the ſaid Point of Interſection) ſet at an equal diſtance from theſe two Poin and the end of the Style be kept at his due ſtance from the Point in the Subſtyl. right un it (either by driving or bending the Support or both, as you ſee cauſe) it ſhall be truly plac then skrew on the Nut, but not too hard.

9. In ſome Dials (North Faces eſpecially) Style fitted to the due Length, may reach yond the Plain: If for the ſetting the Style to juſt Height, you would find the diſtance of end of it from a Point taken near the end of Subſtylar. the Length of the Style and the diſta of the ſaid Point from the Center, are two ſi of a Triangle, comprehending a known Ang *viz.* the Height of the Style; ſo the Sum of other two Angles being known, by *Prop.* 4. y may find both theſe Angles, and by *Prop.* 3. third ſide, which is the diſtance ſought; but i placed beſt over ther Subſtyl. by marking a Po in the top of the Style, and proceeding accordi to the former Direction.

CHAP. XV.

To find the Altitude of the Sun at every Ho in any Day in the Year.

1. IF the Sun be in the Æquator,
As the Radius
To the Coſine of the Latitude,
So the Coſine of the Hour from the Merid
To the Sine of the Altitude.

2. If the Sun hath Declination, the Merid Altitude will be found by the Declination.

If the Hour be ſix,
As the Radius
To the Sine of the Latitude,

So the Sine of the Declination
 To the Sine of the Altitude.

3. If the Hour be neither twelve nor ſix,
As the Coſine of the Hour from the Meridian
 To the Radius,
So the Tangent of the Latitude
 To the Tangent of a fourth Ark.

Then, if the Latitude and Declination be both ke, as with us in the North Latitude, North eclination, and the Hour be between Noon and , take the Declination out of the fourth Ark, e Remainer ſhall be a fifth Ark.

But if either the Latitude and Declination be like, or the Hour fall between Six and Mid- ght, add the Declination to the fourth Ark, e Sum ſhall be the fifth Ark.

Then, As the Sine of the fourth Ark
 To the Sine of the Latitude,
So the Coſine of the fifth Ark
 To the Sine of the Altitude.

So for any one Latitude you may gather your rth Arks into a Table, each againſt his own ur, and againſt them in another Column the fferences between their reſpective Sines and e Sine of the Latitude, ſo are they ready for e; for having found the fiſth Ark, you are on- to ſubtract the Difference out of the Coſine ereof; the Remainer is the Sine of the Alti- de required.

Sun's Declination.

Days.	*Jan.*	*Febr.*	*March*	*April*	*May*	*Jun*
	South	South	South	North	North	Nor
1	21 41	13 42	3 20	8 40	18 7	23
2	21 31	13 22	2 56	9 2	18 22	23
3	21 21	13 2	2 32	9 23	18 37	23
4	21 10	12 41	2 9	9 45	18 51	23
5	20 58	12 21	1 45	10 6	19 6	23
6	20 47	11 59	1 21	10 27	19 19	23
7	20 34	11 38	0 59	10 48	19 33	23
8	20 22	11 17	0 34	11 9	19 46	23
9	20 9	10 56	0 10	11 30	19 59	23
10	19 56	10 34	No.13	11 50	20 11	23
11	19 42	10 12	0 37	12 11	20 23	23
12	19 28	9 50	1 01	12 31	20 35	23
13	19 14	9 28	1 24	12 50	20 46	23
14	18 59	9 6	1 48	13 10	20 57	23
15	18 44	8 43	2 11	13 30	21 8	23
16	18 29	8 21	2 35	13 49	21 18	23
17	18 13	7 58	2 38	14 8	21 28	23
18	17 57	7 36	3 22	14 27	21 38	23
19	17 41	7 13	3 45	14 45	21 47	23
20	17 24	6 50	4 8	15 3	21 56	23
21	17 7	6 27	4 31	15 21	22 4	23
22	16 50	6 4	4 54	15 39	22 12	23
23	16 32	5 40	5 17	15 57	22 20	22
24	16 14	5 17	5 40	16 14	22 27	22
25	15 56	4 54	6 03	16 31	22 34	22
26	15 38	4 30	6 26	16 48	22 41	22
27	15 20	4 7	6 49	17 4	22 47	22
28	15 0	3 43	7 11	17 21	22 53	22
29	14 41		7 33	17 37	22 58	22
30	14 22		7 56	17 52	23 3	22
31	14 2		8 18		23 7	

An. 1681 1685 1689

July	*Aug.*	*Sept.*	*Oct.*	*Nov.*	*Dec.*
North	North	North	South	South	South
22 4	15 6	4 17	7 21	17 43	23 8
21 56	14 48	3 54	7 44	17 59	23 13
21 47	14 30	3 31	8 6	18 15	23 16
21 38	14 11	3 8	8 29	18 31	23 20
21 28	13 52	2 45	8 51	18 46	23 23
21 18	13 33	2 21	9 13	19 1	23 25
21 8	13 14	1 58	9 35	19 16	23 27
20 58	12 54	1 35	9 56	19 30	23 28
20 47	12 35	1 11	10 19	19 44	23 29
20 35	12 15	0 48	10 40	19 57	23 30
20 24	11 55	0 24	11 2	20 10	23 30
20 12	11 35	0 1	11 23	20 23	23 30
19 59	11 14	So. 22	11 44	20 36	23 29
19 47	10 53	0 46	12 5	20 48	23 27
19 34	10 33	1 9	12 26	20 59	23 25
19 20	10 12	1 33	12 46	21 11	23 23
19 7	9 51	1 56	13 7	21 21	23 20
18 53	9 29	2 20	13 27	21 32	23 17
18 38	9 7	2 44	13 47	21 42	23 13
18 24	8 46	3 7	14 7	21 51	23 9
18 9	8 24	3 30	14 26	22 1	23 4
17 54	8 2	3 54	14 45	22 9	22 59
17 38	7 40	4 17	15 4	22 18	22 54
17 22	7 18	4 40	15 23	22 26	22 48
17 6	6 56	5 3	15 41	22 33	22 41
16 50	6 34	5 27	16 0	22 40	22 34
16 33	6 11	5 50	16 18	22 47	22 27
16 16	5 48	6 12	16 35	22 53	22 19
15 59	5 26	6 36	16 53	22 58	22 11
15 42	5 3	6 58	17 10	23 3	22 2
15 24	4 40		17 27		21 53

Sun's Declination.

Days.	*Jan.*	*Feb.*	*Mar.*	*Apr.*	*May*	*June*
	South	South	South	North	North	North
1	21 43	13 47	3 26	8 34	18 4	23 11
2	21 33	13 27	3 02	8 56	18 19	23 14
3	21 23	13 7	2 38	9 58	18 34	23 18
4	21 12	12 46	2 15	9 40	18 48	23 21
5	21 1	12 25	1 51	10 1	19 2	23 23
6	20 49	12 5	1 27	10 22	19 16	23 25
7	20 37	11 43	1 03	10 43	19 29	23 27
8	20 25	11 22	0 40	11 4	19 43	23 28
9	20 12	11 1	0 16	11 25	19 55	23 29
10	19 59	10 39	Nor.4	11 45	20 8	23 30
11	19 46	10 17	0 31	12 6	20 20	23 30
12	19 32	9 55	0 55	12 26	20 32	23 30
13	19 18	9 33	1 19	12 46	20 44	23 29
14	19 3	9 11	1 42	13 5	20 55	23 28
15	18 48	8 49	2 05	13 25	21 5	23 26
16	18 33	8 26	2 29	13 44	21 16	23 24
17	18 17	8 4	2 53	14 3	21 26	23 22
18	18 1	7 41	3 16	14 22	21 36	23 19
19	17 45	7 18	3 39	14 41	21 45	23 16
20	17 28	6 55	4 03	14 59	21 54	23 12
21	17 11	6 32	4 26	15 17	22 2	23 8
22	16 54	6 9	4 49	15 35	22 10	23 4
23	16 37	5 46	5 12	15 53	22 18	22 59
24	16 19	5 23	5 35	16 10	22 26	22 54
25	16 1	4 59	5 58	16 27	22 33	22 48
26	15 42	4 36	6 21	16 44	22 39	22 42
27	15 24	4 12	6 43	17 0	22 45	22 36
28	15 5	3 49	7 05	17 17	22 51	22 29
9	14 46		7 28	17 33	22 57	22 22
0	14 27		7 50	17 48	23 2	22 14
31	14 7		8 12		23 6	

An. 1682 1686 1690

July	*Aug.*	*Sept.*	*Oct.*	*Nov.*	*Dec.*
North	North	North	South	South	South
22 6	15 11	4 23	7 15	17 39	23 7
21 58	14 53	4 0	7 38	17 55	23 11
21 49	14 34	3 37	8 1	18 12	23 15
21 40	14 16	3 14	8 23	18 27	23 19
21 31	13 57	2 50	8 46	18 42	23 22
21 21	13 38	2 27	9 8	18 58	23 24
21 11	13 19	2 04	9 30	19 12	23 26
21 0	12 59	1 40	9 52	19 26	23 28
20 49	12 39	1 17	10 13	19 40	23 29
20 38	12 20	0 53	10 35	19 54	23 30
20 27	12 0	0 30	10 57	20 7	23 30
20 14	11 40	0 7	11 18	20 20	23 30
20 2	11 19	So. 17	11 39	20 33	23 29
19 50	10 58	0 40	12 0	20 45	23 28
19 37	10 38	1 04	12 21	20 57	23 26
19 23	10 17	1 27	12 41	21 8	23 24
19 10	9 56	1 51	13 2	21 19	23 21
18 56	9 34	2 14	13 22	21 29	23 18
18 42	9 13	2 38	13 42	21 39	23 14
18 27	8 51	3 01	14 2	21 49	23 10
18 12	8 29	3 25	14 21	21 58	23 6
17 57	8 8	3 48	14 41	22 7	23 1
17 42	7 46	4 11	15 0	22 16	22 55
17 26	7 24	4 34	15 18	22 24	22 49
17 10	7 1	4 58	15 37	22 31	22 43
16 54	6 39	5 21	15 55	22 38	22 36
16 37	6 17	5 44	16 13	22 45	22 29
16 21	5 54	6 7	16 31	22 51	22 21
16 3	5 31	6 30	16 49	22 57	22 13
15 46	5 8	6 53	17 6	23 2	22 4
15 28	4 46		17 23		21 55

Sun's Declination. 1683.

Days.	*Jan.* South	*Feb.* South	*Mar.* South	*Apr.* North	*May* North	*Ju* Nor
1	21 46	13 52	3 31	8 29	18 0	23
2	21 36	13 32	3 8	8 51	18 15	23
3	21 26	13 12	2 44	9 13	18 30	23
4	21 15	12 51	2 20	9 34	18 44	23
5	21 4	12 31	1 57	9 56	18 59	23
6	20 52	12 10	1 33	10 17	19 13	23
7	20 40	11 49	1 9	10 38	19 26	23
8	20 28	11 28	0 45	10 59	19 40	23
9	20 15	11 6	0 22	11 20	19 52	23
10	20 2	10 44	Nor.2	11 40	20 5	23
11	19 49	10 23	0 26	12 1	20 17	23
12	19 35	10 1	0 49	12 21	20 29	23
13	19 21	9 39	1 13	12 41	20 41	23
14	19 7	9 17	1 36	13 0	20 52	23
15	18 52	8 54	2 0	13 20	21 3	23
16	18 36	8 32	2 23	13 40	21 13	23
17	18 21	8 9	2 47	13 59	21 24	23
18	18 5	7 46	3 10	14 18	21 33	23
19	17 49	7 24	3 34	14 36	21 43	23
20	17 32	7 1	3 57	14 55	21 52	23
21	17 15	6 38	4 20	15 13	22 0	23
22	16 58	6 15	4 43	15 31	22 8	23
23	16 41	5 52	5 6	15 48	22 16	23
24	16 23	5 28	5 29	16 6	22 24	22
25	16 5	5 5	5 52	16 23	22 31	22
26	15 47	4 42	6 15	16 40	22 38	22
27	15 28	4 18	6 37	16 56	22 44	22
28	15 10	3 55.	7 0	17 13	22 50	22
29	14 50		7 23	17 29	22 55	22
30	14 31		7 45	17 44	23 0	22
31	14 12		8 7		23 5	

1687 1691

July	*Aug.*	*Sept.*	*Oct.*	*Nov.*	*Dec.*
North	North	North	South	South	South
22 8	15 15	4 28	7 10	17 35	23 6
22 0	14 57	4 5	7 33	17 52	23 11
21 51	14 39	3 42	7 55	18 8	23 15
21 43	14 20	3 19	8 18	18 23	23 18
21 33	14 1	2 56	8 40	18 39	23 21
21 23	13 43	2 33	9 2	18 54	23 24
21 13	13 23	2 9	9 24	19 9	23 26
21 3	13 4	1 46	9 47	19 23	23 28
20 52	12 44	1 23	10 8	19 37	23 29
20 41	12 24	0 59	10 30	19 51	23 30
20 29	12 5	0 36	10 51	20 4	23 30
20 18	11 44	0 12	11 13	20 17	23 30
20 5	11 24	So. 11	11 34	20 30	23 29
19 53	11 3	0 35	11 55	20 42	23 28
19 40	10 43	0 58	12 16	20 54	23 26
19 27	10 22	1 27	12 36	21 5	23 24
19 13	10 01	1 45	12 57	21 16	23 22
19 0	9 40	2 9	13 17	21 27	23 19
18 45	9 18	2 32	13 37	21 37	23 15
18 31	8 56	2 55	13 57	21 47	23 11
18 16	8 35	3 19	14 17	21 56	23 7
18 1	8 13	3 42	14 36	22 5	23 2
17 46	7 51	4 6	14 55	22 14	22 57
17 30	7 29	4 29	15 14	22 22	22 51
17 14	7 7	4 52	15 32	22 29	22 44
16 58	6 44	5 15	15 51	22 37	22 38
16 42	6 22	5 38	16 9	22 43	22 31
16 25	5 59	6 2	16 27	22 50	22 23
16 8	5 37	6 24	16 44	22 56	22 15
15 50	5 14	6 47	17 2	23 1	22 6
15 33	4 51		17 19		21 58

Sun's Declination. 1684

Days.	*Jan.* South	*Feb.* South	*Mar.* South	*Apr.* North	*May* North	*J* No
1	21 48	13 57	3 13	8 46	18 10	23
2	21 38	13 37	2 50	9 7	18 27	23
3	21 28	13 17	2 26	9 29	18 41	23
4	22 18	11 56	2 2	9 51	18 55	23
5	21 7	12 36	1 39	10 12	19 9	23
6	20 55	12 15	1 15	10 33	19 23	23
7	20 43	11 54	0 51	10 54	19 36	23
8	20 31	11 32	0 28	11 15	19 49	23
9	20 19	11 11	0 4	11 35	20 2	23
10	20 5	10 50	No.20	11 56	20 14	23
11	19 52	10 28	0 43	12 16	20 27	23
12	19 38	10 6	1 7	12 36	20 38	23
13	19 24	9 44	1 30	12 56	20 42	23
14	19 10	9 22	1 54	13 15	21 0	23
15	18 55	9 0	2 18	13 35	21 11	23
16	18 40	8 37	2 41	13 54	21 21	23
17	18 24	8 15	3 5	14 13	21 31	23
18	18 9	7 52	3 28	14 32	21 40	23
19	17 53	7 29	3 51	14 50	21 49	23
20	17 36	7 7	4 14	15 8	21 58	23
21	17 20	6 44	4 38	15 26	22 7	23
22	17 2	6 21	5 1	15 44	22 14	23
23	16 45	5 57	5 24	16 2	22 22	22
24	16 27	5 34	5 47	16 19	22 29	22
25	16 10	5 11	6 9	16 36	22 36	22
26	15 51	4 47	6 32	16 52	22 43	22
27	15 33	4 24	6 55	17 9	22 49	22
28	15 14	4 1	7 17	17 25	22 54	22
29	14 55	3 37	7 39	17 41	22 59	22
30	14 36		8 2	17 56	23 4	22
31	14 16		8 24		23 9	

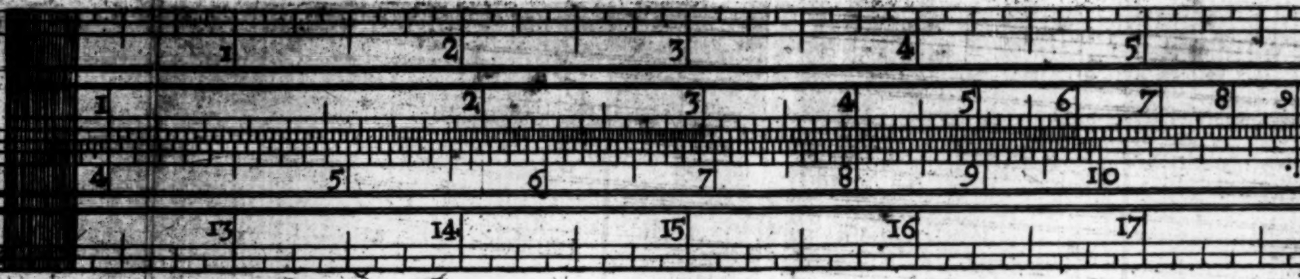
1688 1692

July	Aug.		Sept.		Oct.		Nov.		Dec.	
orth	North		North		South		South		South	
2	15	1	4	11	7	27	17	48	23	9
54	14	43	3	48	7	50	18	4	23	14
45	14	21	3	25	8	12	18	20	23	17
35	14	6	3	2	8	35	18	35	23	21
26	13	47	2	38	8	57	18	50	23	23
16	13	28	2	15	9	18	19	5	23	26
5	13	9	1	52	9	41	19	20	23	27
55	12	49	1	28	10	3	19	34	23	29
44	12	29	1	5	10	25	19	47	23	30
32	12	10	0	41	10	46	20	01	23	30
21	11	49	0	18	11	8	20	14	23	30
8	11	29	Sou.	6	11	29	20	27	23	29
56	11	8	0	29	11	50	20	39	23	28
43	10	48	0	53	12	11	20	51	23	27
30	10	27	1	16	12	32	21	2	23	25
17	10	6	1	40	12	52	21	13	23	22
3	9	45	2	3	13	12	21	24	23	19
49	9	23	2	27	13	32	21	35	23	16
34	9	2	2	50	13	52	21	44	23	12
20	8	40	3	13	14	12	21	54	23	8
5	8	18	3	37	14	31	22	3	23	3
50	7	56	4	0	14	50	22	12	22	58
34	7	34	4	23	15	9	22	20	22	52
18	7	12	4	47	15	28	22	28	22	46
2	6	50	5	10	15	47	22	35	22	39
46	6	27	5	33	16	5	22	42	22	32
29	6	5	5	56	16	23	22	48	22	25
12	5	42	6	19	16	40	22	54	22	17
55	5	20	6	42	16	58	23	0	22	9
37	4	57	7	5	17	15	23	5	22	0
20	4	34			17	31			21	51

A TABLE of Seconds for rectifying the Table of the Sun's Declination.

	Ja	*Fe*	*M*	*A.*	*M.*	*J.*	*J.*	*A.*	*Se.*	*O.*	*N.*	*D*
	Se	Se	Se.	Se	Se.	Se	S	S	Se	Se	Se	S
1	17	36	43	40	2	8	15	33	42	41	30	
2	18	37	43	39	2	7	15	34	43	42	29	
3	19	37	43	40	27	6	16	35	43	42	29	
4	20	38	44	40	27	5	17	35	43	42	28	
5	20	37	44	39	26	4	18	34	43	41	28	
6	21	37	43	39	25	4	19	35	43	41	28	
7	21	38	43	38	25	3	19	35	44	41	27	
8	22	39	43	38	24	2	19	35	43	40	26	
9	23	38	44	38	23	2	20	36	44	40	25	
10	24	38	45	37	23	1	21	36	43	40	24	
11	25	39	44	37	22	0	21	37	43	40	24	0
12	25	40	44	37	22	1	22	38	43	39	23	0
13	26	41	43	36	21	1	22	38	43	39	22	
14	26	40	44	36	20	2	23	38	44	38	21	
15	27	41	44	35	20	3	23	38	43	38	21	
16	28	42	43	35	19	4	24	39	44	37	20	4
17	28	41	42	35	19	4	25	39	43	38	20	5
18	29	41	43	35	18	5	26	39	43	37	19	6
19	30	41	43	34	17	6	26	39	43	37	18	7
20	31	42	42	34	17	7	27	40	43	36	17	8
21	31	42	43	33	16	8	27	40	43	36	16	9
22	32	42	43	33	15	8	28	41	44	35	16	10
23	32	43	43	32	14	9	29	40	43	35	15	11
24	32	43	42	32	14	10	29	41	42	34	14	12
25	33	44	42	31	13	11	30	41	43	34	13	12
26	33	44	41	31	12	12	30	41	42	33	13	13
27	34	43	41	30	11	13	30	41	42	34	12	14
28	34	43	41	29	10	13	31	42	42	33	11	15
29	35	43	41	29	9	14	31	41	43	32	11	16
30	35		41	29	9	14	32	42	42	32	10	16
31	36		41		8		33	42		31		17

Fig: I



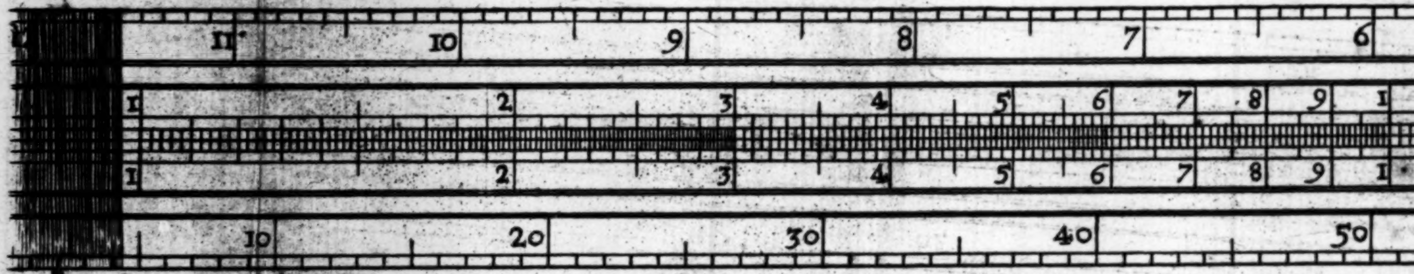
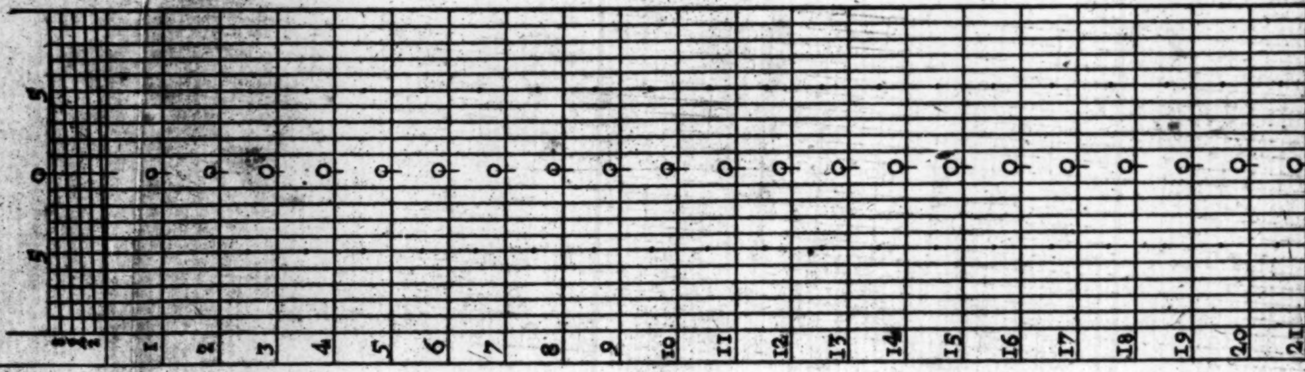


Fig: III.
16 Poles in an Inch.



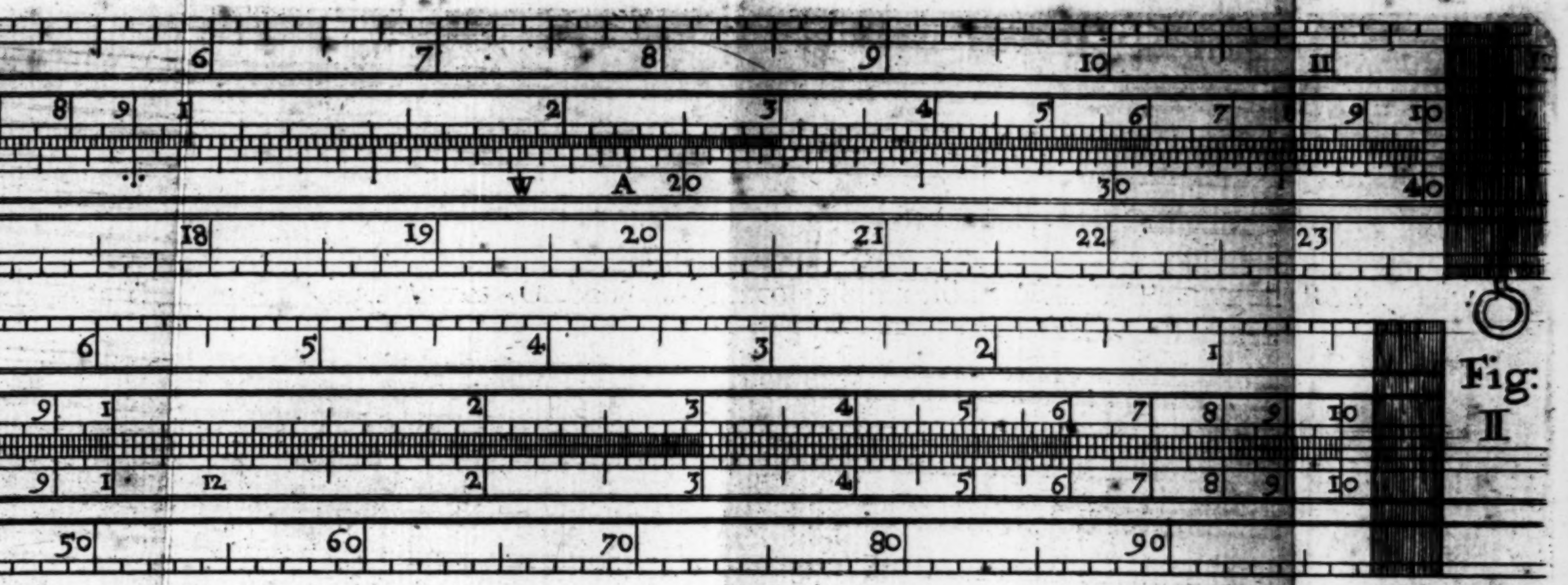
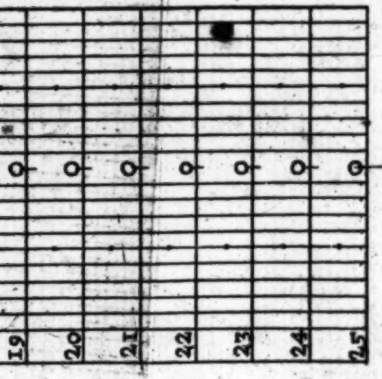


Fig. II



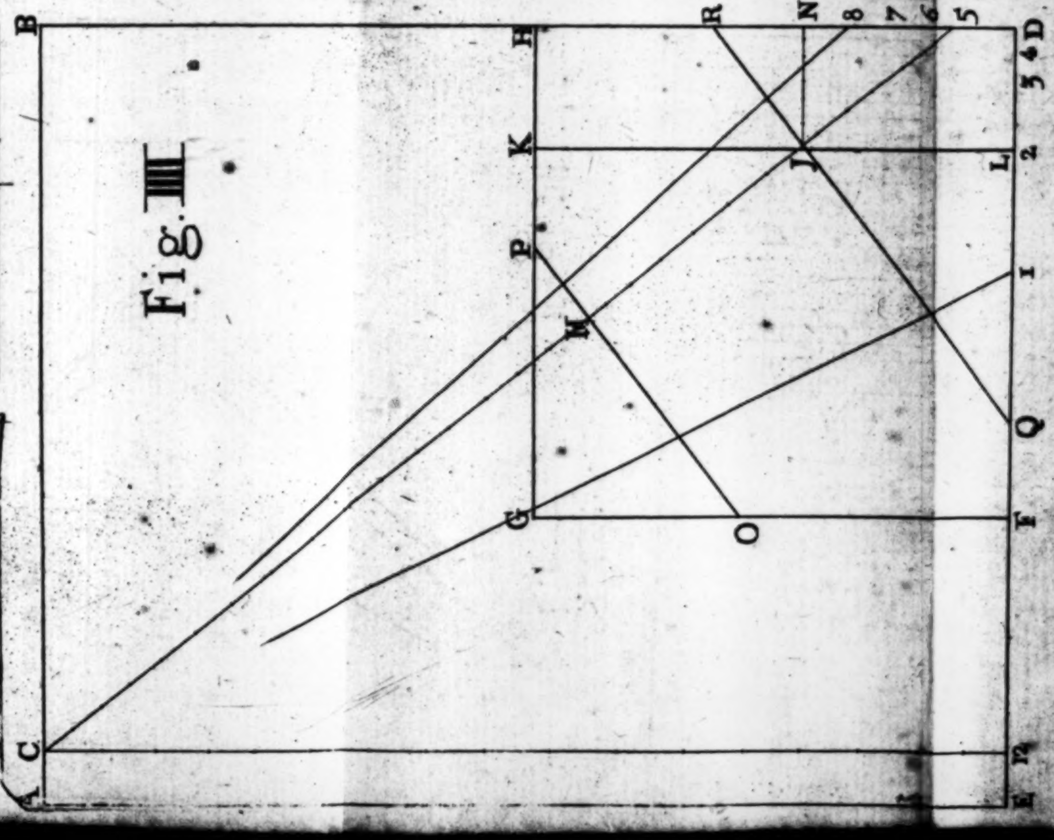


Fig. IIII

The Uſe of the Table of Seconds.

We will ſuppoſe that the Tables of the Declin. were calculated for the four middle Years, *viz.* 1685, 1686, 1687, 1688.

Subtract 1688 out of the Year to which you would rectify the Declination.

The Difference divide by 4; if any Number remain, it ſhews in which of the three former Years you muſt ſeek the Declination; if nothing remain, ſeek it in the laſt.

By the Quotient (being the Number of Leap-years paſt ſince 1688) multiply the Seconds found in this Table againſt the Day of the Month in which you ſeek the Declination.

Divide the Product by 60; the Quotient add to the Declination in the Table, if the Declination increaſeth, *viz.* in the Spring or Autumn Quarter; but deduct it if the Declination decreaſeth, *viz.* in the Summer or Winter Quarters; the Sum or Remainer is the true Declination for that Day at Noon.

Then for the Hours before or after Noon,

As 24

To the difference of the Declination in the Table in Minutes for one Day before or after;

So the Hour from Noon

To his proportional Part, which muſt be added or deducted according as the Declination increaſeth or decreaſeth; alſo with reſpect to the Time before or after Noon.

Example. I would know the Declination of the Sun at 7 in the Morning on the firſt Day of *April* 1723, taking 1688 out of 1723, the difference is 35, which divided by 4, the Quotient is 8, and there remains 3, which ſheweth that you muſt ſeek the Declination in the third Table.

The Seconds in the Table are 40, which multiplied by the Quotient, the Product is 320, this divided by 60, the Quotient is 5, the Remainer may be collected in this caſe.

The Declination in the Table is 8° 29′ increaſing, to which if you add the ſaid 5, the Sum 8° 34′ is the Declination that Day at Noon.

The difference for a Day before or after is 22; on the double Scale ſet 24 to 22, againſt 5, the Hour from Noon, is 4.6, which you may call 5, for we regard not Parts, as is before ſaid.

This muſt be deducted out of the Declination at Noon, becauſe the Declination increaſing, it is not amounted to that at Noon by ſo many Minutes.

To

To gauge a Cask which is not full.

A TABLE for gauging of Wine Casks which are not full.

G.	parts.	G.	parts.	G.	parts.	G.	parts.	G.	Parts.
0	000	13	2630	26	4330	39	5913	52	7672
1	295		2703		4400		5976		7758
2	470	14	2775	27	4462	40	6040	53	7829
1	602		2847		4542		6094		7909
2	720	15	2918	28	4585	41	6158	54	7990
	830		2986		4646		6223		8072
3	935	16	3056	29	4706	42	6288	55	8154
	1038		3123		4766		6353		8236
4	1138	17	3189	30	4826	43	6418	56	8319
	1235		3255		4885		6483		8404
5	1329	18	3321	31	4943	44	6548	57	8491
	1420		3387		5000		6613		8580
6	1502	19	3452	32	5057	45	6679	58	8661
	1596		3517		5115		6745		8765
7	1681	20	3582	33	5174	46	6841	59	8862
	1764		3647		5234		6877		8962
8	1846	21	3712	34	5294	47	6944	60	9065
	1928		3777		5354		7012		9170
9	2010	22	3842	35	5415	48	7082	61	9280
	2091		3906		5476		7153		9398
10	2171	23	3960	36	5535	49	7225	62	9530
	2242		4024		5600		7297		9705
11	2328	24	4087	37	5662	50	7370	63	10000
	2405		4150		5724		7444		
12	2481	25	4213	38	5787	51	7519		
	2556		4270		5850		7595		

The Uſe of the Table.

FInd the Content of the whole Cask, and the Depth of the Liquor therein, being the wet Part of the Bung diameter, the Axis of the Veſſel being horizontal or level; as the Diameter at the Bung in Inches to the Depth of the Liquor, ſo 10,000, the Radius of the Table, to the proportional Part; find in the Table the ſaid Parts, or neareſt, and note the Gallons and Parts anſwering; then as 63, the Gallons in a Wine Hogſhead, to the Gallons noted, ſo the Content of the whole Cask to the Content of the Liquor in the Cask.

Gunter's *Chain otherwiſe diſtinguiſhed.*

THE Diſtinction of this Chain, as I have uſed it above thirty Years, without finding the leaſt Inconvenience or Cauſe to alter it, I have here inſerted.

At ten Links, and at thirty Links from each end, let there be a braſs Curtain-Ring, or (if you like it better) a round braſs Plate; at 20 Links, and at forty Links from each end, ſuch another Ring, with a red, yellow, or ſome other remarkable coloured Rag, ſewed, or otherwiſe faſtned thereto; at 25 Links from each end two ſuch Rings together; at 50 Links a large braſs Ring of about an Inch and half diameter.

The Convenience of this Diſtinction.

1. THE Surveyor of Land will ſometimes find his Chain at the end of the meaſured Line, lying in Stubble, long Graſs, or Weeds, ſometimes foul with Mire or Dirt, thro' which it hath been led, or in which it lieth; in ſuch caſe the Rags are eaſily diſcoverable.

2. They being but four, and accounted 20, 40, 60, 80, from each end, the Link that determines the Length of the Line is ſpeedily found.

3. Every Mark of diſtinction in the Chain, except one, repreſenting two Numbers, the Rags and Rings are free for either; but that which is defined to one, and yet muſt as often ſignify another, may be the cauſe of Loſs of Time, or (which is worſe) of a Miſtake.

Notwithſtanding it is free to any to diſtinguiſh his Chain as he pleaſeth.

25 OC62

ADVERTISEMENT.

WHereas the Tables of Logarithms, of Sines, Tangents, and natural Numbers, had they been inſerted, would have ſwelled this Book, and thereby advanced the Price beyond the Deſign thereof, I recommend to the Reader *Gellibrand's* Inſtitution Trigonometrical, wherein are Tables of the natural Sines, Tangents, and Secants, and alſo the Log. Sines and Tangents; together with a Table of Log. as far as 10,000, in a very fair Figure, and very true. There is ſuch another in every reſpect by one *Vlacq* a *Dutchman*. One of theſe, with Mr. *Wingate's Tabulæ Logarithmicæ*, recommended in the Book, will be ſufficient for almoſt any Mathematical Practice, and he will reap by them the Satisfaction, which will abundantly anſwer the Charge.

FINIS.

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